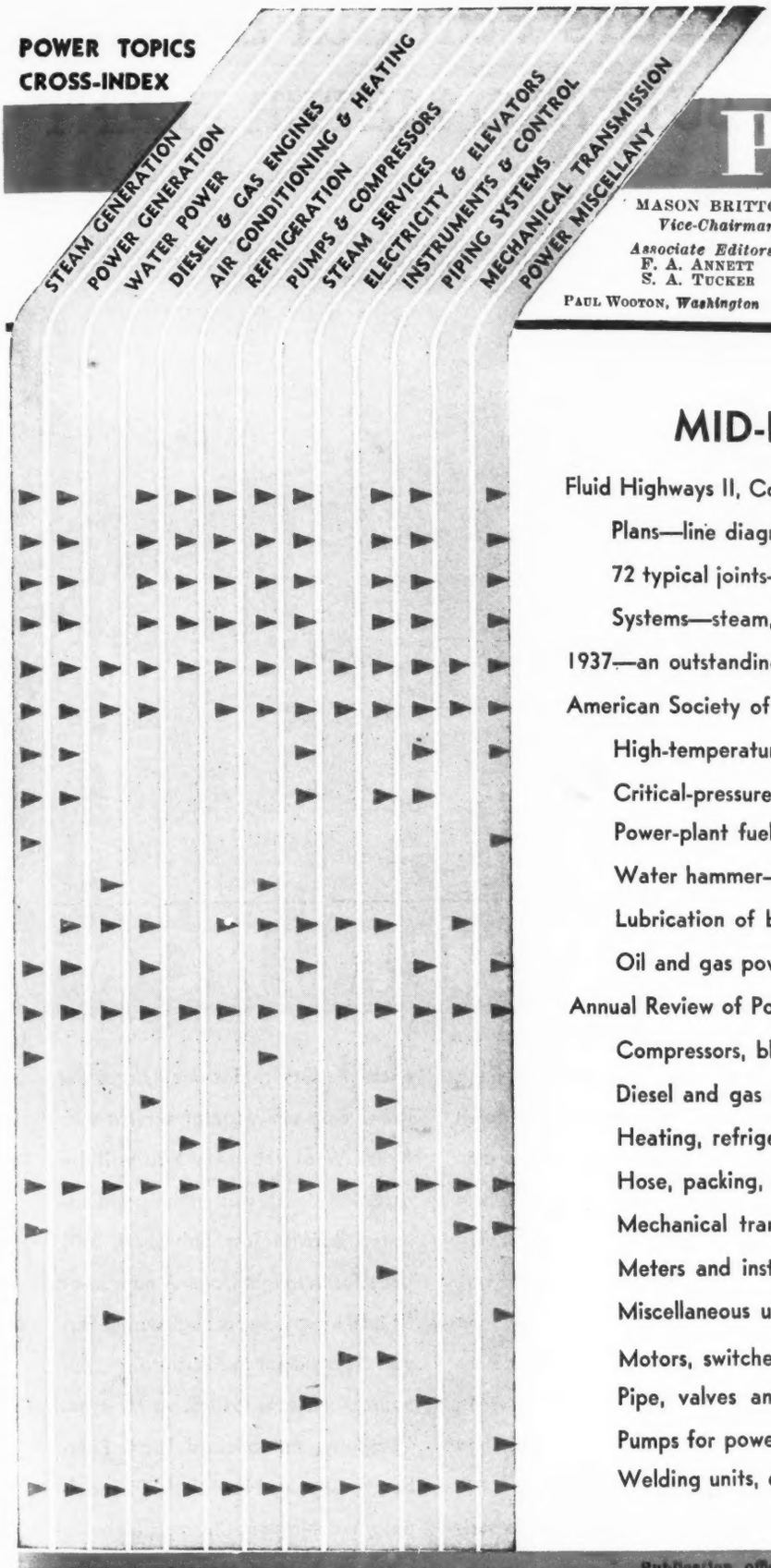

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POWER

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MID-DECEMBER, 1937

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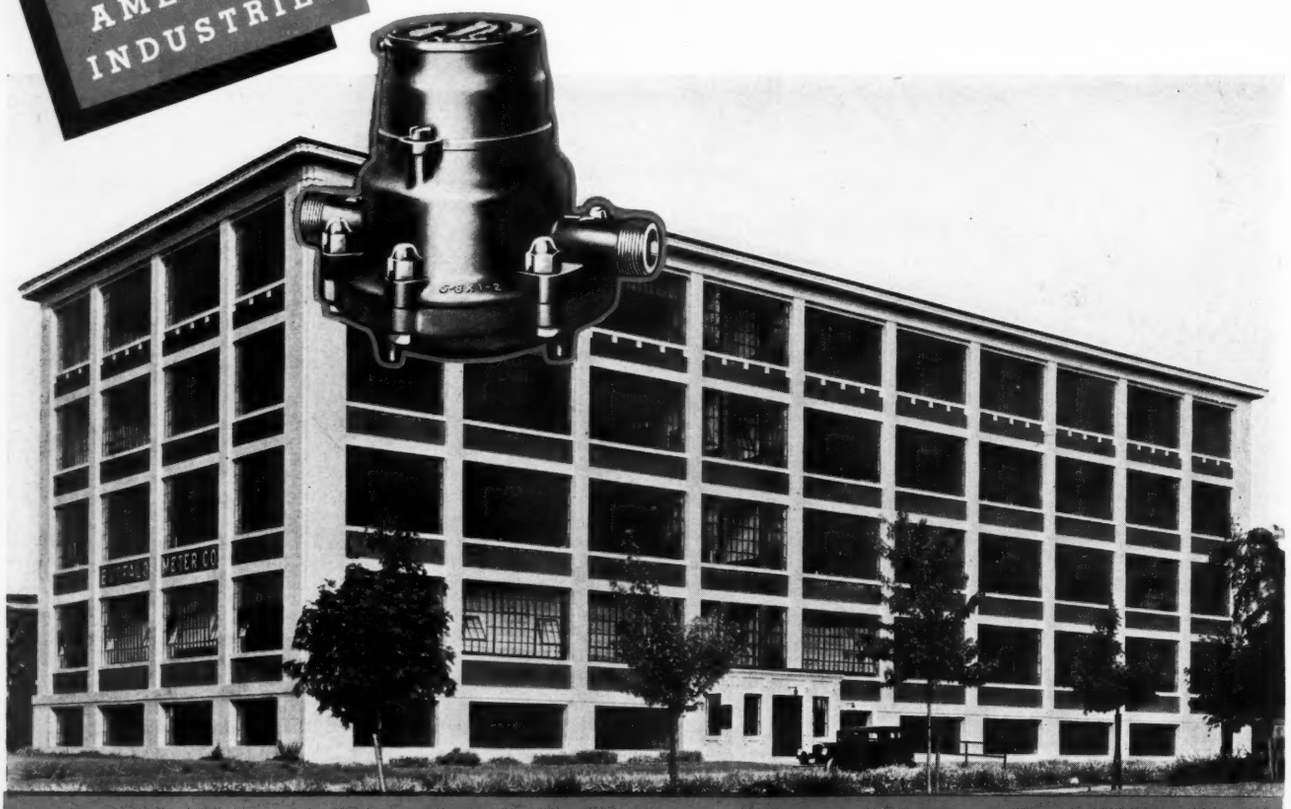
21 Years Faithful Service in BUFFALO METER PLANT



BYERS WROUGHT IRON

● When the Buffalo Meter Company erected this building in 1916 they demanded in materials the same high quality which they put into their famous Niagara Liquid Meters. For services where resistance to corrosion was essential, Byers Wrought Iron was used, based on previous experience with it.

Now, 21 years later, comes the confirmation of the wisdom in selecting Byers Wrought Iron. No replacements have been made during 21 years in the hot and cold water lines, oil and air lines, vents and down spouts. Byers Wrought Iron is also now being used for replacements in steam supply and return lines.

Further than this, because Byers Wrought Iron has made good on its reputation for resistance to corrosion, Mr. Robert S. Bassett, treasurer of the company, uses it in his residence.

Why not benefit by this experience? Reduce replacements and get lower cost-per-year of service with Byers Wrought Iron. You will be especially interested in the new illustrated booklet just published, "101 Uses for Wrought Iron." A copy may be had by writing our Engineering Service Department in Pittsburgh or our nearest Division Office. A. M. Byers Company. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

BYERS GENUINE WROUGHT IRON

Tubular and Flat Rolled Products

Specify Byers Genuine Wrought Iron Pipe for corrosive services and Byers Steel Pipe for your other requirements

POWER

ESTABLISHED 1882

FLUID HIGHWAYS II

Fluid Highways—I appeared in December.

PIPING SYSTEMS

ANY MAN who has ever sat with the elements of a jigsaw puzzle littered around him knows that parts alone are not enough—you must also have the knowledge and the skill to put them together. In December *Power*, we pictured the elements, the pipe, valves, fittings and specialties which go to make up a piping system. Now we propose to show how these elements are put together into coordinated, practical units.

A hundred years ago, every piping installation followed its own rules. But between 1820 and 1840 English engineers agreed upon a standard series of pipe diameters up to 10 inches, and in 1862 Robert Briggs worked out the threading standard which now bears his name. When these were adopted in the United States in 1886, we had the first real basis for sound piping.

Through the intervening years, our endless search for advancement has brought new processes and new methods, each with its increased demands for piping to withstand ever-higher pressures and temperatures or stronger corrosives. The high-pressure boiler would be impossible without a piping system able to withstand superheated steam; rayon and plastics would still be laboratory processes without acidproof tubing. But these systems are not elements alone; just as important is proper combination, the working out of every little detail so that it becomes part of a coordinated whole.

In these sixteen pages, the editors have attempted this coordination. And beyond that, we have endeavored to show procedure—the necessary steps which must be gone through before even piping materials are selected. Included are the little things—the oft-forgotten details that often spell the difference between success and failure.

Many of these things are new—developed within the past several years—but the basic ideas go back beyond the memory of man. For man himself is but one tremendous piping system, a flexible, portable arrangement of seamless interlaced tubing equipped with fittings, valves, checks, separators, coolers, traps and strainers, carrying a dozen or more fluids and with a service life, barring accident, of upwards of threescore years. Given another fifty years of development as productive as the last fifty, man may be able to design a synthetic system almost as efficient. At least, he can try.

PLANS

Piping layout requires most careful planning. Proper line diagrams, drawings and specifications save money when construction starts

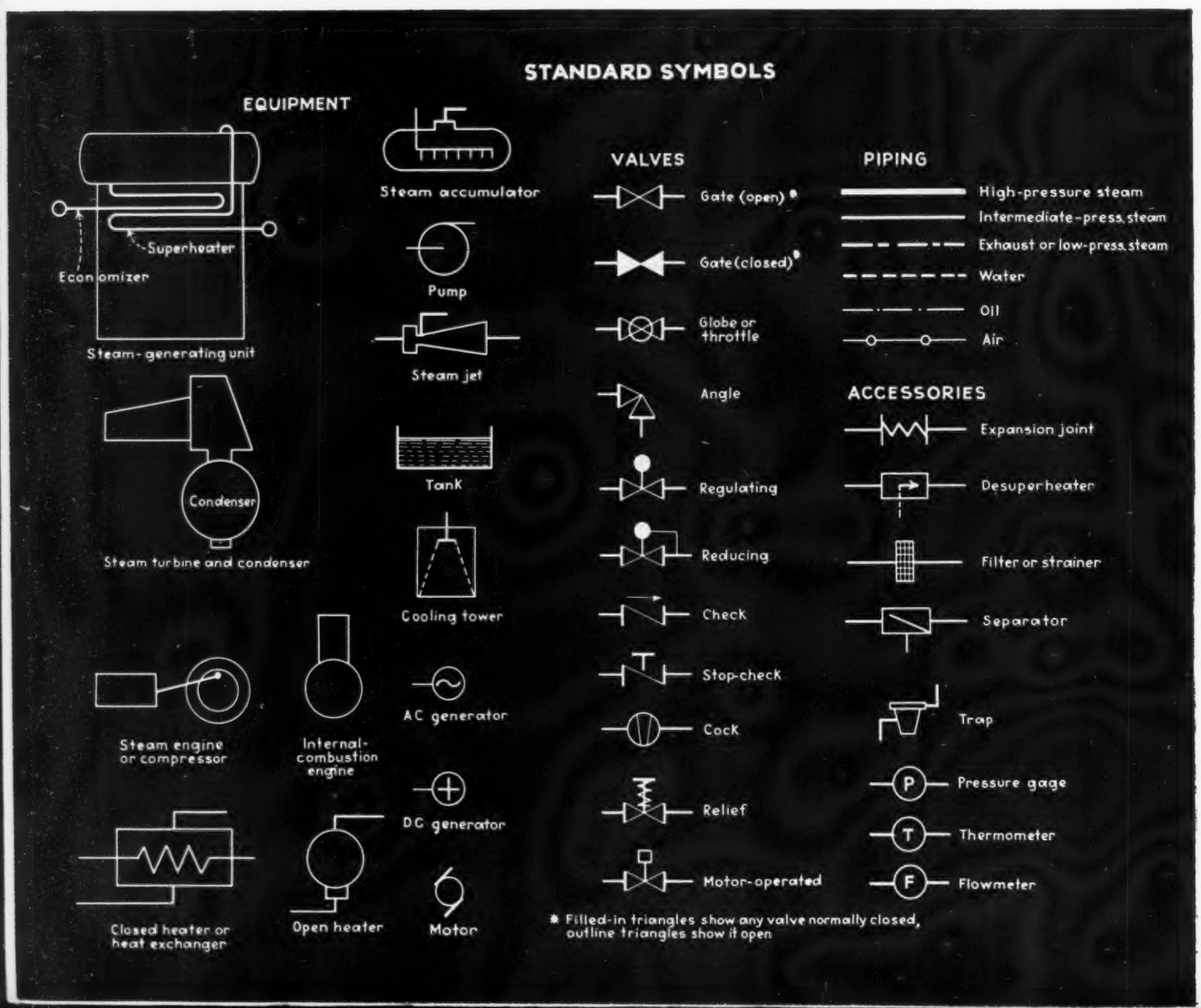
Line Diagrams

POWER-PLANT PIPING systems do not, like Topsy, just grow. Sometimes the designer is faced with only a simple connection for which the proper material, size, valving and layout is obvious; more often several kinds of pipe are suitable at different costs, layout can be varied to improve operating flexibility, a change in line size affects the cost of pumps, or there are other options, the selection among which must be made on an economic basis or from experience.

Whether the piping job is a minor addition to an existing plant system or a major construction project, it is important that the several parties concerned reach agreement at an early stage on what lines are to be installed and how they shall be arranged. Not only the layout draftsman, but also the construction forces and the operators, should examine preliminary plans to be sure that requirements are met, and to check that all the piping planned is necessary.

Practice among piping designers differs somewhat, but the starting point is usually a schematic single-line diagram showing connections to equipment, valves, strainers and traps. Line diagrams can be very simple, showing only a general idea to be carried out

No set of symbols will fit all cases. When those below do not apply, invent others which represent your equipment and are simple to draw



in detail later, or they can become detailed with pipe sizes, fittings and materials specified. How much detail should appear depends on the purpose for which the diagram is to be used. To get a new idea across to a non-technical executive, a diagram without too many details shows what is planned in a way that can be understood at a glance. The same plan submitted to a contractor for bid may have to be in great detail.

Line diagrams are much used because they are a flexible tool. They can be adapted to show much or little as required. They are a shorthand method of drawing and as such employ symbols which represent various equipment and parts of the piping system. In presenting a series of symbols, *Power* attempts only to show simple ways of representing usual kinds of equipment. Valves, for example, should be shown by a symbol easy to make because it is so often repeated, and once understood does not need to look like a valve. Special equipment, on the other hand, should often be shown in sufficient schematic detail so the reader can understand its functions. A wide latitude of choice exists for each designer to use in representing his own ideas.

Where only one system is shown on one diagram, full lines can be used to represent pipe. However, when high and low-pressure steam, as well as condensate piping, is drawn on the same sheet, varying the weight of line and using dashes or dots aids clarity. The only requirements are that the diagram be clear and that it show enough detail to accomplish whatever purpose is intended by the designer.

Drawings

LINE DIAGRAMS serve a useful purpose in settling what connections are to be made and what valves and other equipment are necessary to proper functioning of the system. They do not take the place of working drawings. An attempt to put in even a simple pipe line according to a line diagram leaves an important part of the designer's job to be done by the construction crew, namely, determination of the length of various sections of pipe and number and location of joints and fittings. Necessary instructions for supports and insulation are also a function of the working drawings.

Determination of pipe size and material is necessary before drawings can be started. The following pages contain charts which help in the selection of pipe size; materials available have already been discussed in December *Power*.

Armed with a reasonably complete line diagram agreed upon by all concerned as to what the piping system is to accomplish and notations as to sizes and materials, the piping draftsman has a fair chance of laying out pipe details which the construction crew can install without taking the building apart and without too many costly extras.

Drawings should leave nothing to the imagination. There may be many ways the piping can be run; someone has to select what appears to be the best route from the standpoint of reliability, appearance and ease of operation. The time to do the selecting is before the drawings are made and the pipe is delivered; experience with extras comes high.

The cost of a piping system can be greatly affected by care in preparation of drawings. Every error, every poor choice, shows up in dollars at the end of the job. Few are gifted with the knack of making pipe drawings so that the finished job looks and is right, and they didn't learn it from books.

Assembly drawings, as well as details, are required on large projects. They help keep down the number of interferences between the many lines and between piping and passageways. Headroom should be considered too. Clearance for installation as well as insulation and flanges, and accessibility of valves add to the designer's problems. In some cases, models, expensive as they are, have saved their cost many times over in the avoidance of mistakes.

There are two ways in general use for taking care of expansion in piping due to temperature change. Expansion joints take up all the pipe movement at the joint; when no expansion joint is used, the pipeline must be flexible enough to take up the expansion at elbows or bends without exceeding safe stresses in the material. Creased bends or corrugated pipe, as well as expansion loops, are often used to increase the flexibility of the line.

Remember these points when writing specifications:

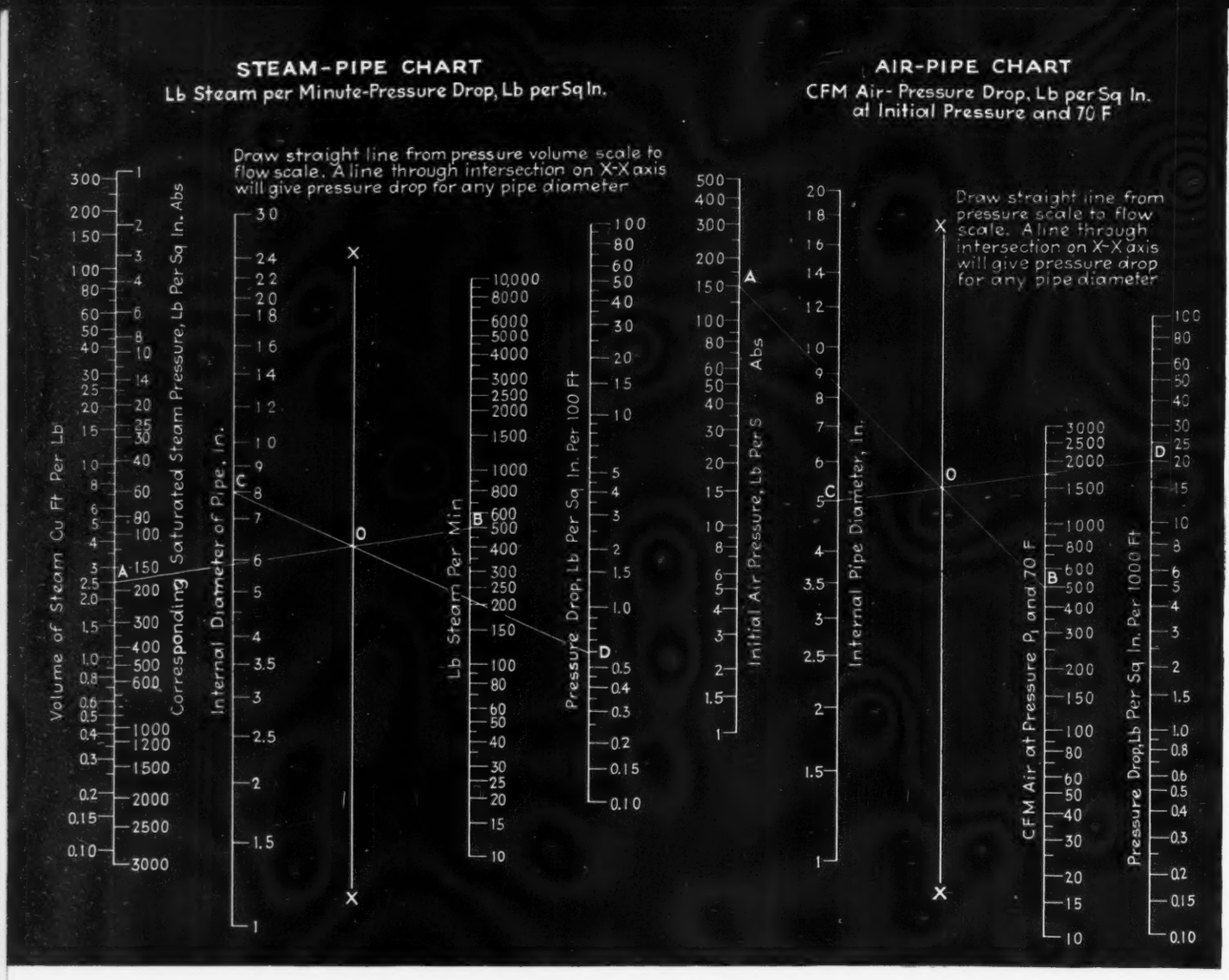
Definition of Terms
Scope of Work
Furnishing and Interpretation of Drawings
Changes in Work
Engineer's Status—Authority and Supervision
Routing and Shipment of Materials
Unloading and Storage of Materials
Distance to Plant Site from Unloading Point
Facilities
Use of Railroad Siding and Switching Facilities
Provision for Erector's Office—Telephone—Tool House
Use of Crane—Electric Power or Compressed Air
Scaffolding—Openings in Walls and Roof
Excavation and Backfilling
Permits
Labor Situation (Union—Non-Union—Housing Conditions)
Prosecution of Work in Harmony with Other Contractors
Insurance and Patent Rights
Erection
Tests
Work Performed by Others—Sub-contractors
Defective Work
Removal of Debris
Termination of Contract
Guarantee
Temporary or Trial Usage
Title to Material
Failure to Execute Contract
Damages
Delivery and Completion
Extras and Additions
Form of Contract
Right to Reject Bids
Terms of Payment
Furnishing of Bond
Any Other Items Desired by Purchaser

The calculation of the expansion a pipe can safely stand due to its own inherent flexibility are too complex to attempt explanation of the methods here. Methods of analysis are given in the "Piping Handbook" by Crocker & Walker, and a practical graphical method is given in "A Manual for the Design of Piping for Flexibility by the Use of Graphs" by Wirt, Smith and Cope. Several technical papers have also been presented before the ASME in recent years. Abstracts have been published in *Power*.

The determination of expansion requires a decision as to location of anchors and the direction of permissible motion at hangers and supports. Supports should be spaced so that drainage is assured and pipe deflections do not introduce added stresses beyond allowable limits.

Specifications

MANY view a specification as a weird and wonderful document full of legal phraseology and restricted to piping systems with costs in five figures or more. Quite the reverse is true, because a specification need only be a


STEAM-PIPE CHART
Lb Steam per Minute-Pressure Drop, Lb per Sq In.
Draw straight line from pressure volume scale to flow scale. A line through intersection on X-X axis will give pressure drop for any pipe diameter
Volume of Steam Cu Ft Per Lb
Corresponding Saturated Steam Pressure, Lb Per Sq In. Abs
Internal Diameter of Pipe, In.
Lb Steam Per Min
Pressure Drop, Lb Per Sq In. Per 100 Ft
AIR-PIPE CHART
CFM Air- Pressure Drop, Lb per Sq In. at Initial Pressure and 70 F
Draw straight line from pressure scale to flow scale. A line through intersection on X-X axis will give pressure drop for any pipe diameter
Initial Air Pressure, Lb Per Sq In. Abs
Internal Pipe Diameter, In.
CFM Air at Pressure P1 and 70 F
Pressure Drop, Lb Per Sq In. Per 1000 Ft

Quick and approximate solutions of pressure-drop problems in steam and air piping can be made with these charts, accurate enough for most purposes

simple, clear, but *complete* statement of what the purchaser expects to get for his money.

Drawings are usually attached to and made part of a piping specification. From the drawings, a bill of material can be made out by the purchaser, or this step can be left for the contractor. The specification should be definite as to materials and dimensional standards. The simplest as well as most satisfactory way of acomplishing definiteness is by reference to ASA, ASTM or other standard specifications listed in December *Power*. For projects including several classes of pipe, separate sections should deal with each class of pipe. Special material or equipment should be written up in detail.

Check that your specification covers type of joint, whether welded, flanged or threaded, weight of pipe and material, type of valves with information as to bonnet arrangement and disk material. Also make reference to material standards for fittings and flanges, bolting material and gaskets. Be sure the contractor will understand how supports and hangers are to be attached to building steel and who is to make the necessary alterations to the building itself.

The real purpose of writing a specification should be kept in mind all through contract negotiations, namely to accomplish a "meeting of minds" between purchaser and contractor as to what shall be delivered, how erected and what constitutes a finished job. Misunderstandings are usually the result of incomplete or obscure wording of the specification. Great expense is incurred in handling small details as extra items.

Pressure Drop

FLUID FLOW, like any other form of motion, is retarded by friction. Long pipe lines, rough pipe walls, small pipe, high rates of flow, many bends and fittings; all spell friction, and consequently a great loss of pressure between one end of the pipe and the other. Pressure drop must be made up somewhere, usually by pumping.

Most of the factors that increase friction are not within the control of the piping designer. Length of line and direction are fixed to a great extent by physical conditions in the plant, and rate of flow is fixed by other considerations. The designer's problem is to match pipe sizes and pressure drops. In a new installation a balance must be struck between the investment in piping, which is increased by using larger pipe sizes, and the investment

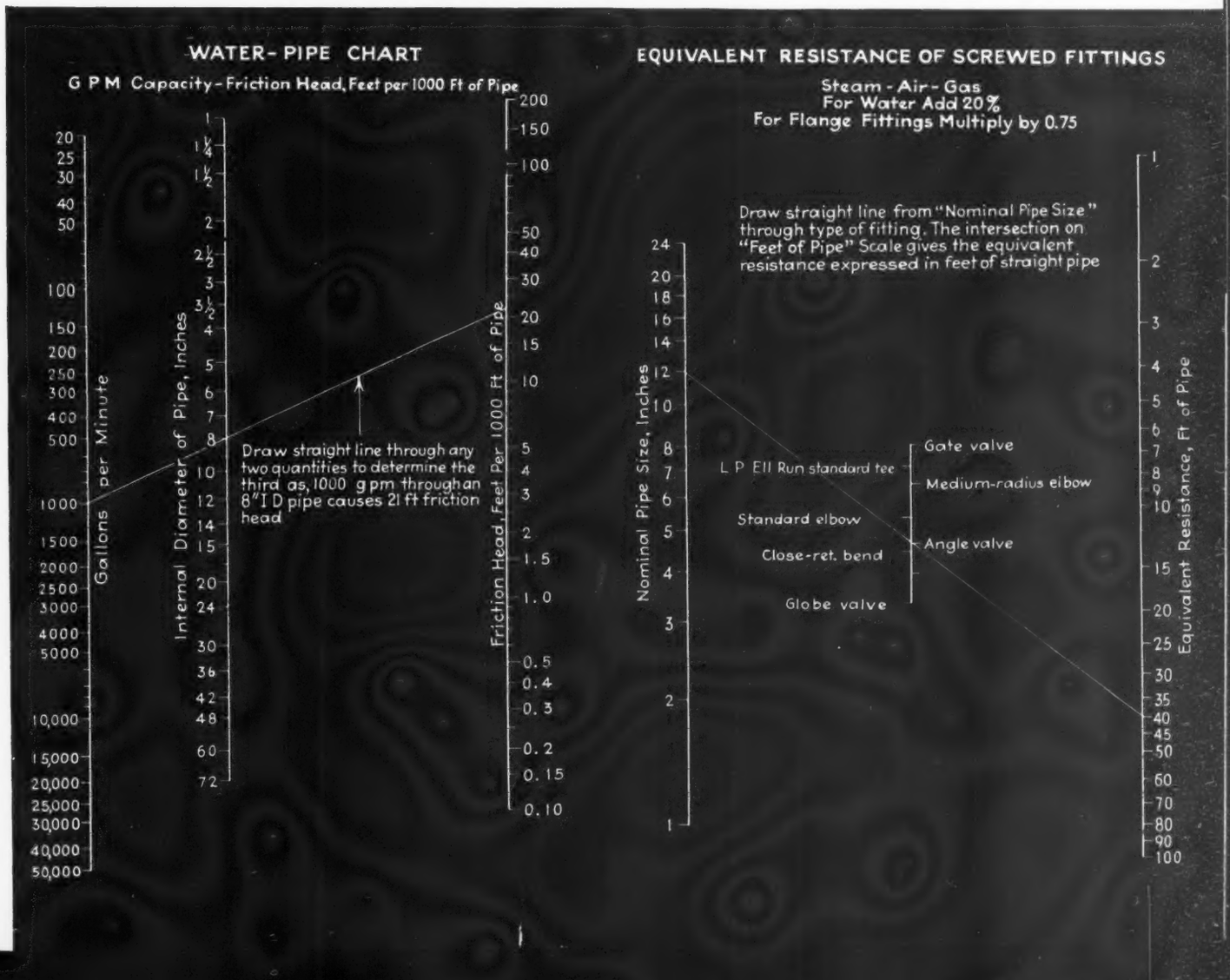
in pumping equipment and the cost of pump operation, both of which are increased by using small pipe sizes with consequently greater pressure drops. In modifying existing systems or extending them, the problem is almost entirely one of selecting a pipe size that will give the desired rate of flow with the pressure available.

It is customary to limit velocities to certain ranges for different fluids and kinds of service. These recommendations are based on experience and represent desirable conditions. They can be exceeded where circumstances warrant. A velocity of 120-300 ft per min is recommended for city-water service and of 300-600 fpm for boiler-feed and general service. Steam flow in boiler leads is usually based on a velocity of 6,000-12,000 fpm; in supply and exhaust lines for engines and pumps, 6,000-9,000 fpm; supply and exhaust lines for turbines 9,000-15,000 fpm; main and auxiliary headers, 9,000-15,000 fpm; and auxiliary steam and exhaust lines, 6,000-12,000 fpm.

Numerous formulas are available for calculating pressure drop, mainly based on experience with particular fluids under particular conditions. These are gradually being superseded by the "rational" formula, which applies to all fluids and all conditions. In this formula, pressure drop is shown to be affected by pipe diameter, by velocity, by length of pipe and by a friction factor. The friction factor, in turn, is affected by the rate of flow, the viscosity and density of the fluid and to some extent by the roughness of the pipe wall. Use of the formula is more or less complicated and to simplify the work various charts have been prepared to give quick answers of an approximate nature. Charts for steam, air and water, taken from the National Valve & Mfg. Co's *Datalog*, are reproduced on these pages. Each is drawn according to the rational formula, but an average friction factor has been used for each fluid. For more accurate results, the true variable friction factor should be applied but the charts are adequate for any but the most refined calculations. Two points should be remembered in connection with the steam chart. The pressure-volume scale is made for saturated steam; for superheated steam refer to steam tables for the specific volume, then to the volume side of the scale. Since the density and viscosity of steam change rapidly with pressure, the chart is not adapted for direct use on long lines with high pressure drops, as it is based on initial pressure. Where the pressure drop exceeds 10% of the initial pressure, divide the line into sections and calculate the pressure drop in each separately, using the final pressure at the end of the first section as the initial pressure in the second section, etc.

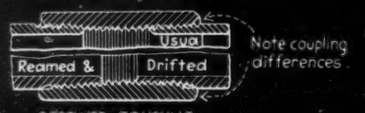
Fittings, valves and bends introduce additional resistance due largely to eddy currents and turbulence. Resistance of a fitting, valve or bend is usually expressed as so many feet of pipe —the "equivalent length." Existing values, as given by different experimenters differ widely. The chart, also from the National Valve & Mfg. Co.'s *Datalog*, gives one set of values, conservative in general with the possible exception of the data for elbows, which are low in comparison with other sources. In using equivalent lengths from any source, it is best to err on the conservative side and increase the values, particularly if resistance of fittings, valves, and bends is a large part of the total.

Pressure drop in water piping can be approximated with the left-hand chart; the right-hand one gives equivalent resistance of fittings

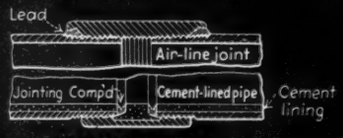

WATER-PIPE CHART
G P M Capacity - Friction Head, Feet per 1000 Ft of Pipe
Gallons per Minute
Internal Diameter of Pipe, Inches
Friction Head, Feet Per 1000 Ft of Pipe
Draw straight line through any two quantities to determine the third as, 1000 g pm through an 8" I D pipe causes 21 ft friction head
EQUIVALENT RESISTANCE OF SCREWED FITTINGS
Steam - Air - Gas
For Water Add 20%
For Flange Fittings Multiply by 0.75
Draw straight line from "Nominal Pipe Size" through type of fitting. The intersection on "Feet of Pipe" Scale gives the equivalent resistance expressed in feet of straight pipe
Nominal Pipe Size, Inches
L P Ell Run standard tee
Standard elbow
Close-ret. bend
Globe valve
Gate valve
Medium-radius elbow
Angle valve
Equivalent Resistance, Ft of Pipe

72 TYPICAL

THREADED



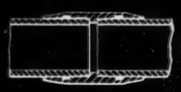
SCREWED COUPLING
Smaller sizes, low T and P. T changes cause high maintenance. Threading cuts strength and thickness 40%.



SPECIAL COUPLINGS
Typical of many. Upper has coupling with end recess for lead packing, lower special coupling with joint compound.

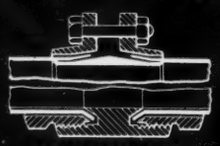
SOLDERED

BRAZED COUPLING
1300-F alloy requires oxy-acetylene torch to melt. Fast, vibration proof, no threading, can be re-used.



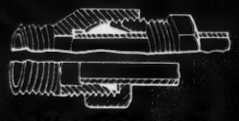
SOLDERED COUPLING
Cast bronze or stainless with soft, hard or silver solder ring. As above, but lower T, depending on alloy.

COMPRESSION



FLARED COUPLINGS
Principally for copper. Tube must be flared, thus harder to make and unmake joints, but tight, sturdy.

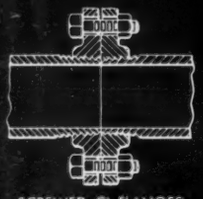
CRIMPED COUPLING-NIPPLE
Also mainly for copper. Tubing crimped against a bevel, thus requires beveling. Tight, easy to remake.



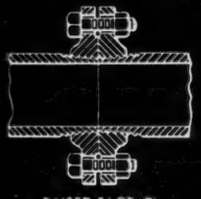
INSERT COUPLING-NIPPLES
3-part, for pipe or tubing. Solder sleeve forced tight to seal. Tight, sturdy, careful assembly, no threading.

GASKET COUPLING
For plain-end iron pipe. Follower nut presses gasket retainer against gasket to seal. Fast, tight, costly.

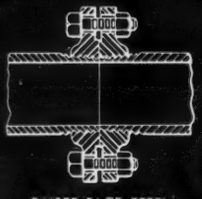
FLANGED



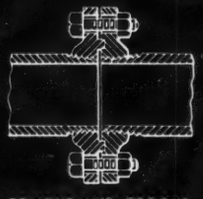
SCREWED CI FLANGES
Inexpensive, good for low P and T under 12-in. diam. Lacks strength. Low gasket pressure, easy blowout.



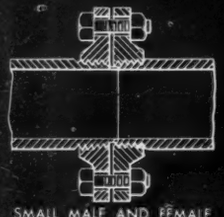
RAISED-FACE CI
Higher unit gasket pressure but must be bolted up carefully to avoid cracking. Never mate with steel flange.



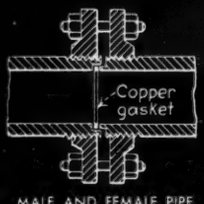
RAISED-FACE STEEL
Better strength, same coef. of expansion as pipe. Flanges refaced after on pipe to avoid distortion.



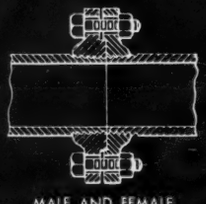
TONGUE AND GROOVE
High gasket pressure. Locks gasket. High T changes crush gasket or mushroom tongue. Hard to erect.



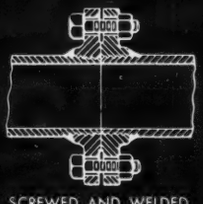
SMALL MALE AND FEMALE
Small hydraulic lines only. Straight threads give easy flange fit. Heavy pipe only with no bending and low T.



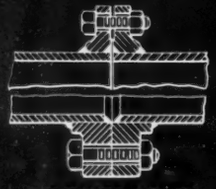
MALE AND FEMALE PIPE
Small hydraulic lines only. Straight threads. Likely to crush gasket. Extra-heavy pipe only. No bending, low T.



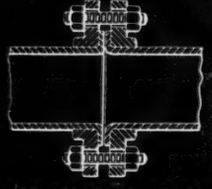
MALE AND FEMALE
More rigidity, avoids excessive gasket pressure, but difficult to lay out, erect, maintain. Gasket nearer bolts.



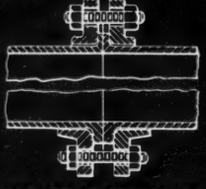
SCREWED AND WELDED
Steel flanges. Avoids thread leakage, but heat of welding causes trouble. Flanges should be refaced after welding.



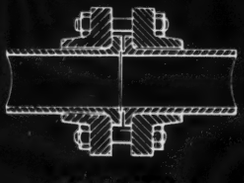
SLIP FLANGE, WELDED
Requires two welds, refacing flanges. No threading. Hard to align bolt holes. Welding neck or butt-welding flange far better.



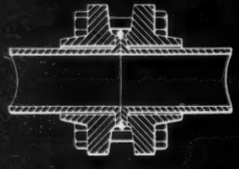
VAN STONE, ROUND LAP
Moderate T, P. Can be formed in place, but warps flange. Non-uniform gasket pressure, thin bend. Almost obsolete.



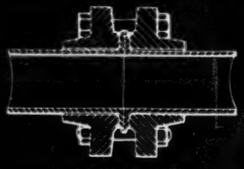
VAN STONE, SQUARE LAP
Medium & high T, P. No water pocket, heavy fillet, rigid, strong. May be seal-welded, usually faced. 200% lap below better.



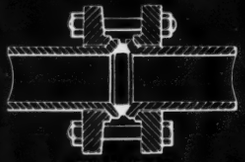
MALE AND FEMALE FACING
Used with double-weight lap. Hard to design, erect and take apart. Extra machining.



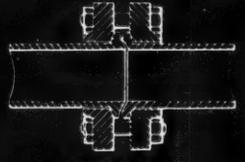
SARGOL JOINT
No gasket, but machined faces. Early Sarlun, unused now due to distortion. Hard to take apart, then remachining or gasket.



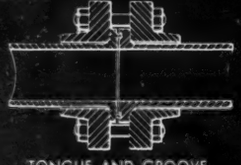
SARLUN JOINT
No gasket, but machined faces. Lips seal-welded. Hard to take apart, then requires remachining or gasket for tightness.



TEXAS JOINT
Up to 6 in. Wedges flanges. Joint may leak under rapid T changes. Water collects in horizontal lines; may leak.



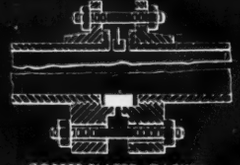
MIDWEST JOINT
Ground spherical contact surfaces. Smaller lines. No gasket, but high-tensile bolts and care in mating.



TONGUE AND GROOVE
Like 200% lap Van Stone. More mating surfaces, harder to erect, design and disassemble; groove weakens lap.

"GLOBACK"
Modified double-thick lap Van Stone, giving wedge action of flanges. Forces outer surfaces of lap together.

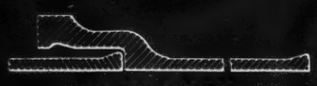
TOROIDAL RING
Inserted ring gives more sealing faces. More machining and greater care in erection. Hard to take down, grooves weaken.



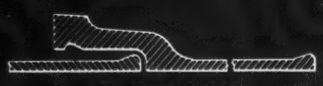
COPPER-PLATED GASKET
Another modification with copper-plated gasket. Used either between flat mating faces or in double-recessed type, as below.

PIPE JOINTS

SCREWED & SPECIAL CI

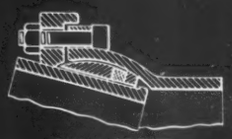


AWA BELL & SPIGOT
V-shaped lock in bell is packed with jute, then lead. As in most CI pipe, joint or fitting is cast integral.



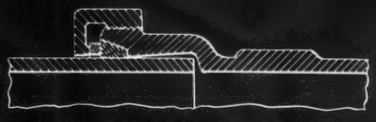
AGA BELL & SPIGOT
Curved lock slot. Also jute and lead packed, but special for gas companies instead of waterworks, as at left.

AGA SPECIAL
Also American Gas Assn., but no locking slot. For cement or combination joint in pipe 4 to 48 in. inside.

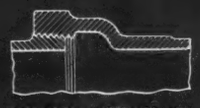


BALL & SOCKET
Joint deflection to 15 deg. Sealing & locking by CI retainer ring, rubber & duck gasket, CI lip ring, CS gland.

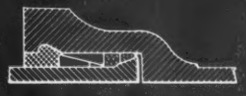
SIMPLE BELL & SPIGOT
Cast-on bead type most commonly used in sizes 2 in. & up. Joints of lead & jute, cement, lead & cement, etc.



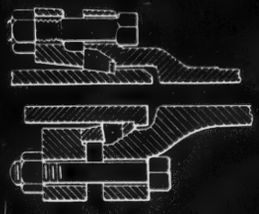
MECHANICAL-JOINT CI
CI octagon gland pulls CI ring against gasket. Plain-end spigot, threaded bell. 2-in. only, stands 250 lb.



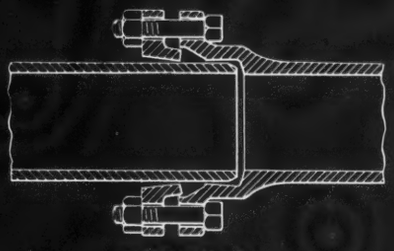
THREADED INTERMEDIATE
Threaded bell & spigot for direct connection. Allows some joint deflection to provide for expansion.



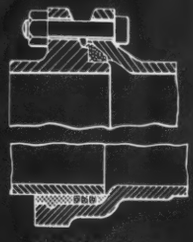
WEDGE BELL & SPIGOT
For AGA standard CI pipe at low and medium pressures. Inner packing jute, rubber wedges, outer caulking lead or cement.



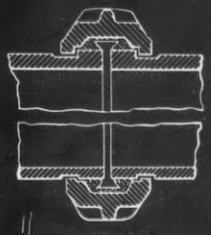
GLAND-LOCK TYPES
Lock-joint avoids end separation. Upper has split steel retainer ring in gasket, lower double CI rings.



GLAND-RING JOINT
Simple gland pulled up by bolts to compress packing against plain, bevel-end spigot, 3- to 36-in. pipe.



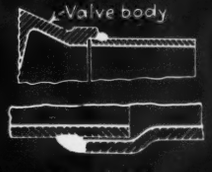
PREPARED JOINT
Jointing materials integral. Upper, 2- to 8-in., has cast-on glands, lower, (2-in. only) requires only caulking.



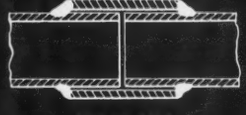
SPLIT COUPLING
Two MI half housings with endless rubber insert ring. Bolted over shouldered (top) or grooved (below) ends.

WELDED

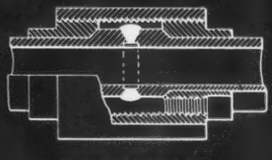
V-BUTT WELD
Very common. Requires skilled welders, careful allowance for T expansion, support, anchoring.



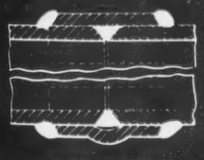
BELL & SPIGOT
Avoids icicles without reducing internal diameter. Small sizes. Requires pipe belling or special fittings.



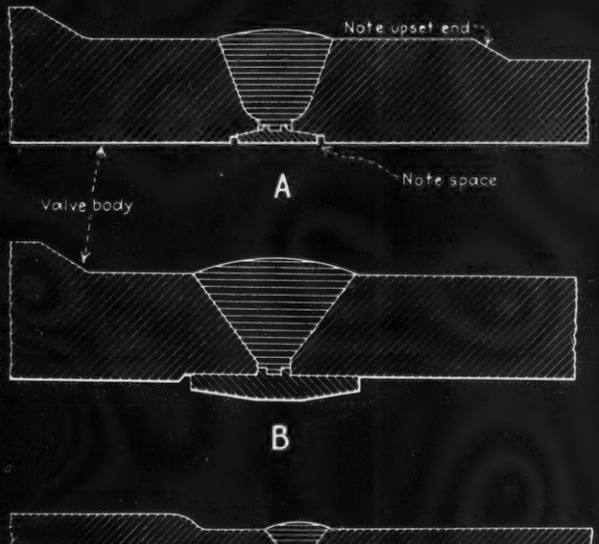
SLEEVE JOINT
Alternate with bell & spigot for small-diameter pipe. No weld on pipe itself, thus avoids expansion cracking.



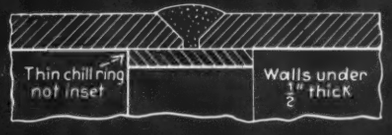
SUPERHEATER JOINT
Designed according to ASME Code. Weld seals joint, then threaded sleeve covers joint and takes tensile stress.

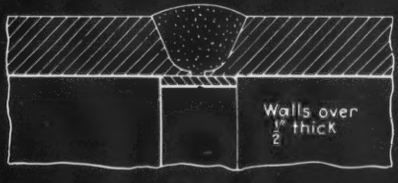


EXTERNAL SLEEVE
Costly, almost obsolete, because stresses cause failure. Upper requires bead grinding, but is smoother.

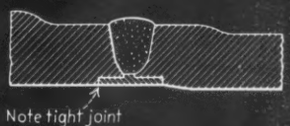


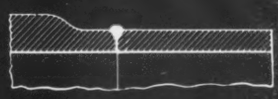
FORD PRACTICE
Examples of butt-welded HP-steam joints in three modern plants are shown as typical of present-day trends, followed by a series showing how weld form is varied, depending upon place of welding, shop or job. Ford at River Rouge uses three joint shapes in carbon-moly, A for 900- and 1500-lb. joints, B for 150-, 300- and 400-lb. joints, and C for 2½ to 5-in. pipe. All have chill rings, A and C being inset so they do not restrict flow. Chill ring has clearance.



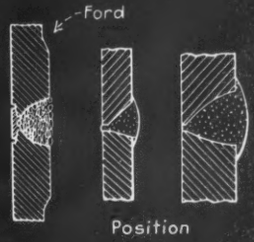


WATERSIDE
Only joints in 2-in. or larger pipe. Under 1½-in. wall thickness uses 45-deg. bevel, over 1½-in. uses curved, both have close-fit chill rings. 1½-in. and smaller have bell & socket joints, above.





ANOTHER UTILITY
Here again, size governs joint shape, above 2-in. being curved, below 2-in. being 30-deg. bevel. Pipe ends are upset to permit insetting of chill ring while retaining full pipe thickness.



SHOP or POSITION WELDING
When joints are made in the shop, the electrode or rod can be held in position and the pipe rotated, giving very uniform weld metal. Position welding requires more passes, plus (sometimes) special joint shapes. Left-hand examples are Ford, others in a HP central station.

SYSTEMS

Diagrams illustrate principles only, and text is a collection of pointers. Coordination of code requirements and operating flexibility makes systems safe and satisfactory. Design of any installation requires the combined efforts of several specialists: layout man, draftsman, constructor, operator

For Steam

CONNECTIONS to and piping immediately adjacent to a boiler are governed by the ASME Power Boiler Code and require insurance-company approval. Other plant piping comes under the American Tentative Standard Code for Pressure Piping. Both codes can be purchased from the ASME.

The Code for Pressure Piping sets a minimum safety standard for selection of suitable materials and refers to standard specifications by which these may be secured. It also designates proper dimensional standards for the elements comprising piping systems, supports, erection, and tests. Setting minimum standards allows selection of better materials or improved construction practice by the designer where desired.

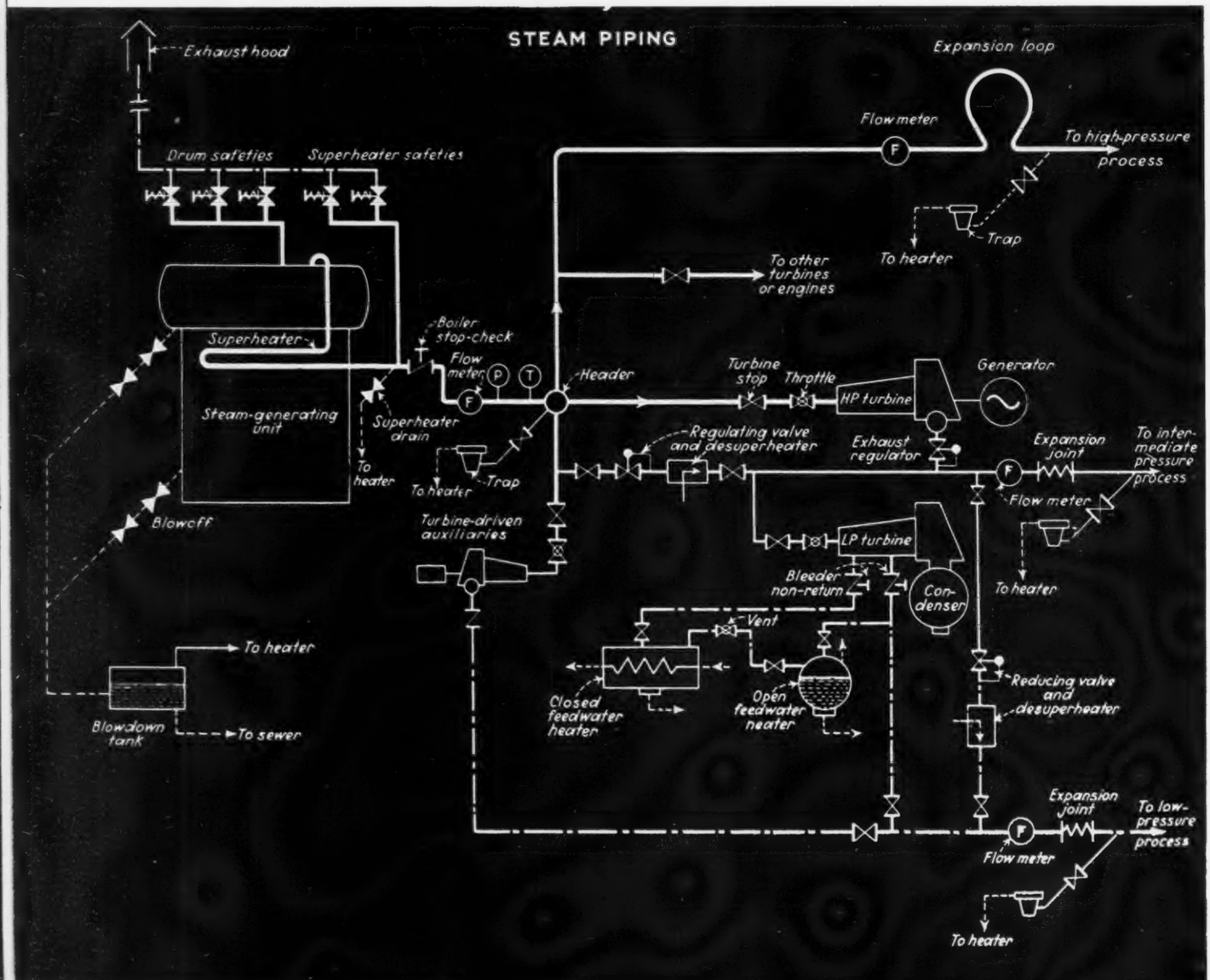
Valves are required to be marked by the manufacturer with reference symbols indicating the service conditions for which they are guaranteed.

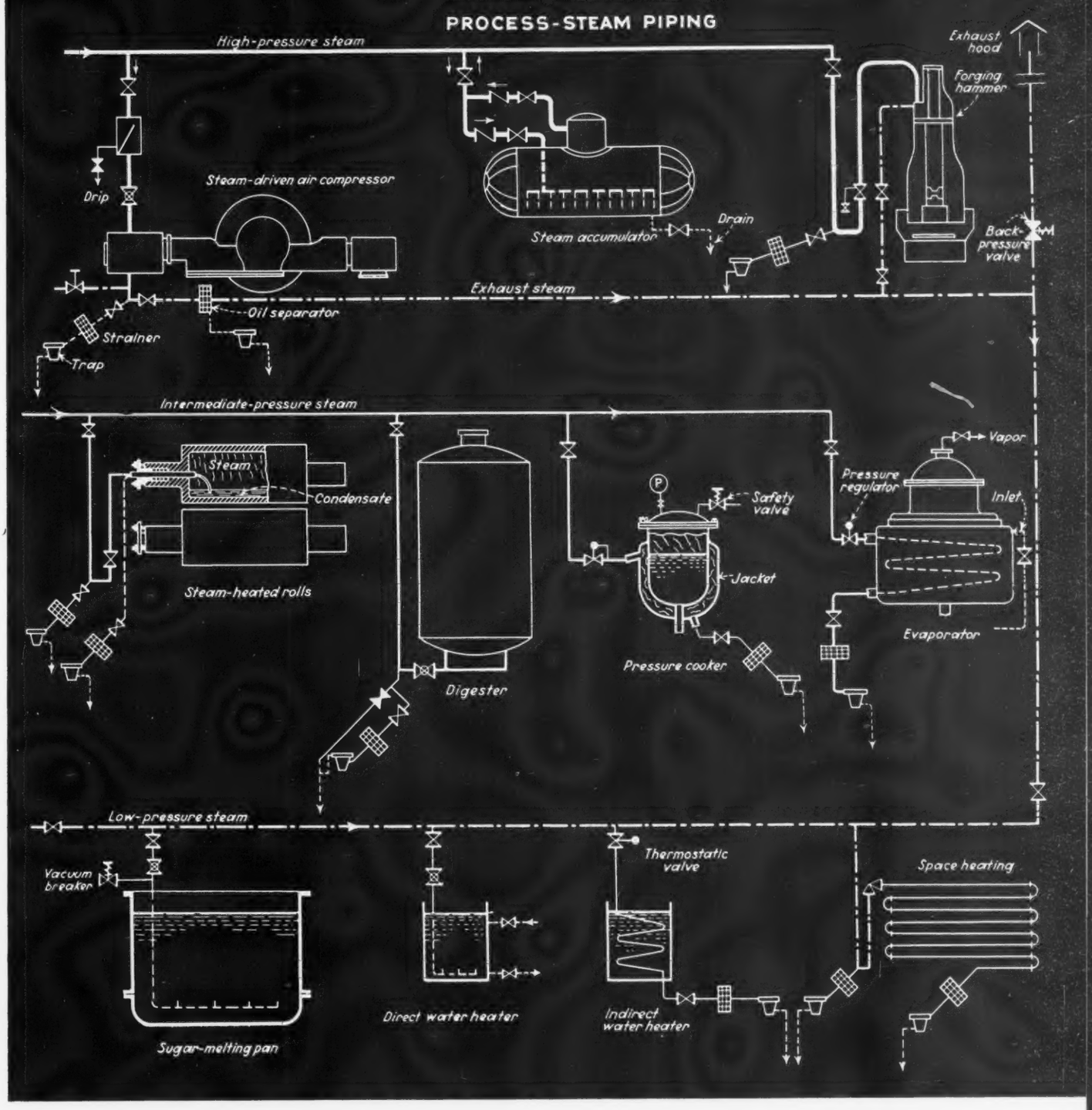
Stop valves for service over 212 F have bonnets backseated to provide for repacking under pressure.

Escaping steam from relief or safety valves must have protection to prevent injury to men or damage to plant. Relief valves shall have adequate capacity to protect low-pressure system if reducing valve sticks open.

It is mandatory that a pressure gage be installed on the low-pressure side of a reducing valve.

General diagram of steam power-piping systems. For a specific plant, diagrams similar to this should show in detail each valve and connection required





Process-plant steam piping deserves attention equal to that given boiler and turbine-room lines. Correct and adequate controls and proper use of traps and accessories result in economy in steam use

Drains or drips are required wherever moisture may collect. At least one valve shall be provided in each drain line. All drain lines are required to be provided with drip valves for free blow to atmosphere.

Remember that steam temperature affects choice of material more than pressure. Also that greater expansion results from increasing temperature limits and requires more attention to hangers and anchors.

Thought given accessibility of valves avoids later need of a ladder or crawling over a maze of piping. Models help visualize complicated setups.

Valves should be located so that condensate will not accumulate above the seat or disk, or should be provided with a special drain.

Welding operators are required to qualify under the Code for Pressure Piping.

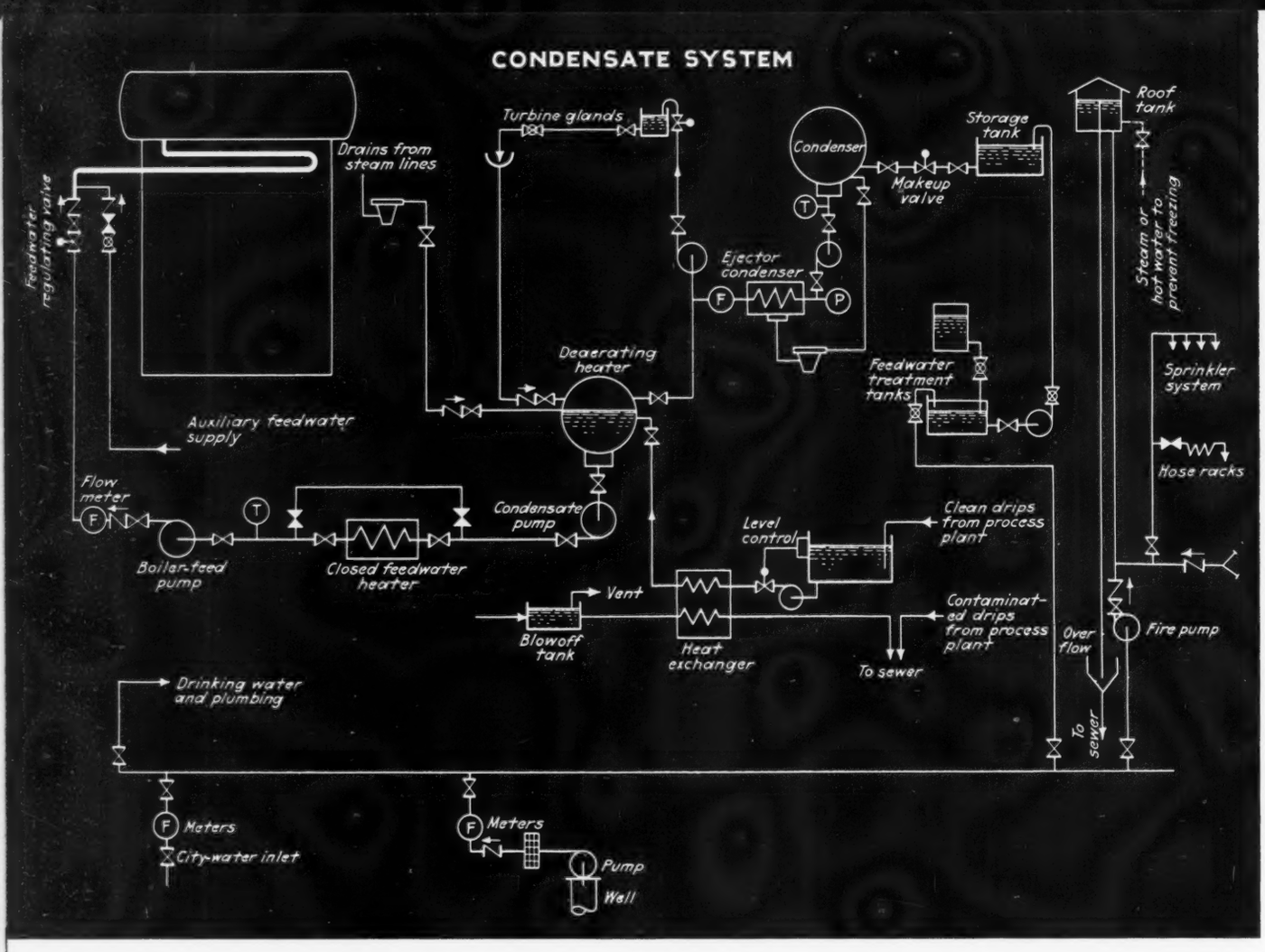
Regulating valves and other special equipment requiring occasional overhaul should be bypassed with at least sufficient manual control to avoid plant shutdowns during maintenance.

Many varieties and makes of valves are available, and selection of the right valve for the job keeps maintenance costs low. December *Power* shows many types; consult manufacturers' catalogues for others.

Use of corrugated pipe or creased bends reduces the number of joints, saves on pressure drop and sometimes eliminates the necessity for expansion loops and joints.

Anchors and supports should be located so that flanged joints are not subjected to bending moment sufficient to overstress the gasket and result in leaks that cannot be made to stay tight.

Two important welding maxims are: Shop-fabricate as much pipe welding as possible. Give the welding operator nothing to do but welding.



City-water, condensate and boiler-feed piping must be designed for maximum reliability and still have flexibility under all conditions of operation

For Condensate

CONNECTIONS TO STEAM boilers for feedwater, water columns and blow-off lines are governed by the ASME Power Boiler Code. Other plant piping is covered by the American Tentative Standard Code for Pressure Piping. Construction of heat exchangers and similar equipment is specified by the Code for Unfired Pressure Vessels.

Fire systems and associated equipment are subject to regulation by local building departments.

Boiler feedwater supply cannot be interrupted for even a few minutes without danger of serious damage to modern boilers. Supply lines to the boiler should be in duplicate, although the emergency connection may be provided with only hand regulation.

Steel is preferred to cast iron for boiler-feed lines and headers for added safety in event of water hammer or shocks due to control-valve operation.

Check valves are required on the high-pressure side of each boiler-feed pump and at each boiler connection.

High points in feedwater and condensate lines should be provided with small valved connections to relieve air in starting. Gate valves are preferred in condensate and other water lines because of their low pressure drop. Globe or other valves are required for regulation of flow.

Suction lines should be short and run as directly as possible to reduce friction loss. They should be graded upward toward the pump to eliminate air pockets.

Suction lines should be designed for the maximum pressure to which they may be subjected by improper operation of valves or be provided with relief valves.

Blowoff lines are subject to severe shock and erosion. They should be not less than extra-heavy weight, and fittings should be cast steel. The Boiler Code requires at least two valves in blowoff connections at each boiler.

Gaskets in suction lines should be installed with extreme care when the line operates under vacuum. Air leakage is difficult to detect and leads to corrosion.

Pure makeup water is important and most supplies require softening. Adequate storage of condensate for makeup should be provided and arranged so that it can be introduced into the feedwater system automatically. Stored feedwater absorbs oxygen if exposed to the air. Make provision for its deaeration on reentry.

Arrange bypasses in any line so that the purpose of each valve is evident at a glance. That avoids costly mistakes.

Trap-discharge piping is to be of the same weight as inlet piping unless the discharge is to atmosphere without stop valves. These lines should be protected against freezing and safeguarded against accident from the hot discharge.

In any system, provision for future extension is cheaply made in early stages of layout and often is costly later.

Neat appearance of any piping is not only a good advertisement for the designer but instills pride and invites good housekeeping by the operator.

For Cooling

COOLING-WATER piping usually operates under low pressure. Strength of material is thus not as important as its corrosion-resisting properties. Selection of material should best be made based on experience with water of the same nature. Cast iron, wrought iron, copper and brass are favored.

Where large quantities of water are available, principal problems are the cost of pumping and ensuring adequate straining. Twin strainers or moving screens allow continued operation even with badly fouled water.

Diesel-engine cooling systems are injured by scale deposits formed in jackets by warming the water. Heat exchangers designed for easy cleaning or completely closed systems are usual.

Cast iron resists the action of salt water. Velocities should be kept low, 5 or 6 ft per second, and eddies and pockets should be avoided as slight erosion tendencies appreciably shorten pipe life.

On small lines, use extra-heavy nipples and fittings with threaded piping because corrosion is most likely to attack at the joints.

Inside surface of pipe should be as smooth as possible to minimize eddies, especially at joints. Flanged pipe is preferred to threaded for this reason. Threaded joints should include reamed pipe-ends.

Piping to roof tanks or cooling towers requires protection against freezing when there is little or no flow.

Duplicate sources of service-water supply to bearings are often warranted by the importance of maintaining adequate supply.

Capacity of service-water pumps is reduced by added suction lift. Suction head at which pumps will operate satisfactorily is affected by temperature as well as intake-canal, sump, or well level.

Expensive materials are often found justified to suit particularly corrosive water conditions. Rubber- and cement-lined pipe offer possible solutions.

Diesel cooling water may pass to a waste-heat boiler or evaporator, or directly into building service, therefore pipe selection is vitally important. Exhaust gas may fall below its dew-point, hence corrode cooling-water pipe exteriors.

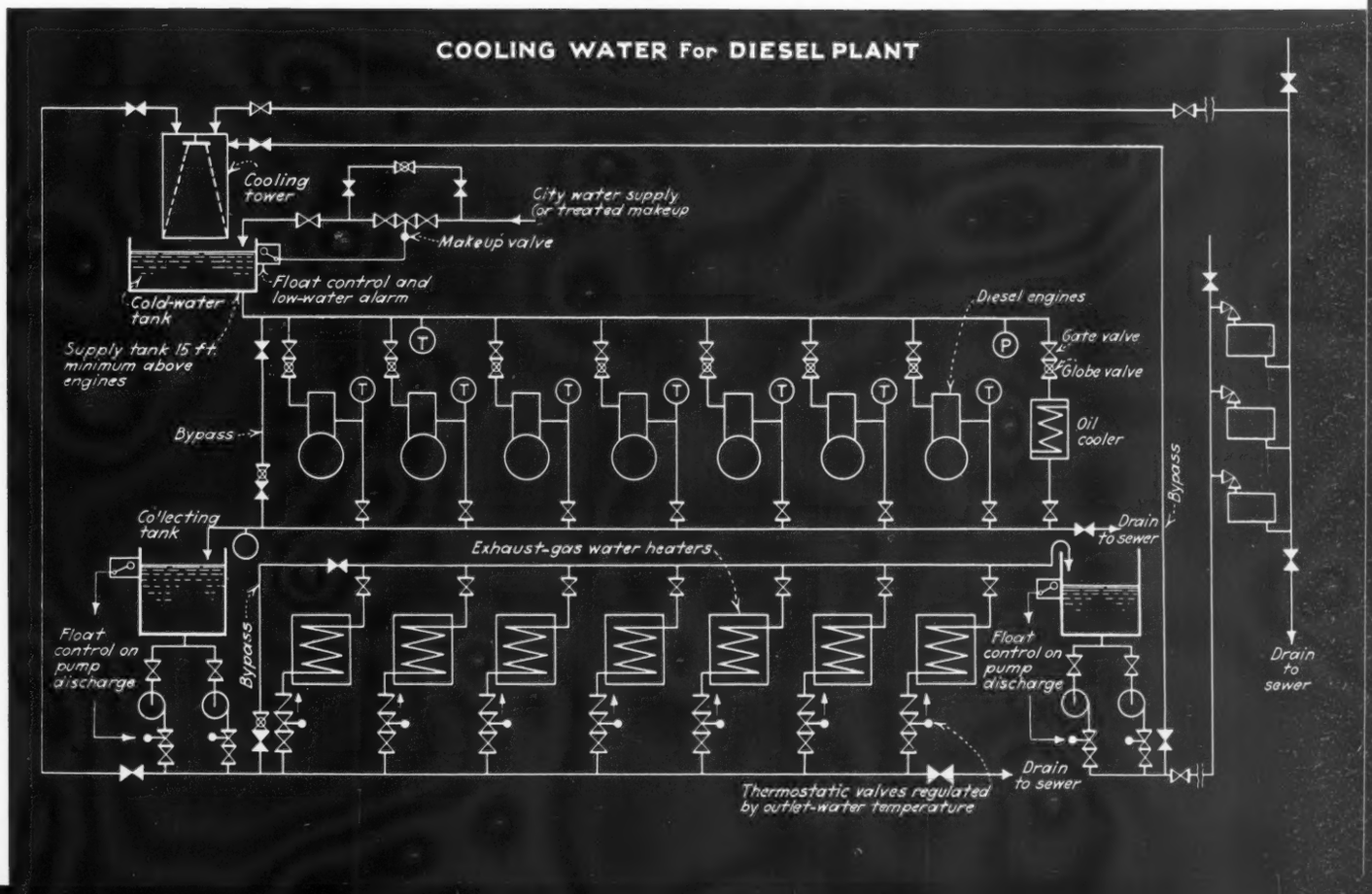
In any pipe line, avoidance of offsets, turns and sharp bends reduces pipe friction and requires smaller pumps and less pumping power. Scale forming in pipe reduces its diameter, hence its capacity; occasional descaling of piping pays big dividends in reduction of pumping costs.

Better materials and more reliable accessories have made piping systems much more trouble-free than they were years ago. Engineers are taking advantage of this fact to simplify piping layouts where possible, resulting in lowered costs without sacrifice of operating flexibility.

Only an operator or one familiar with operation knows what valves and connections are necessary for continued reliable operation. Those elements above all should and must be kept in first-class operating condition at all times.

Material selection can make or break an otherwise entirely correct pipeline. Under ordinary conditions, a corrosion problem may indicate simply that the shift should be to the next cheapest material, to galvanizing of steel or wrought iron or tinning of copper. In severe circumstances, however, the problem is very complicated. Comparative experience of other nearby operators is a reliable index. It stands to reason that if cooling water in a mine plant corrodes steel in a few days' time, no other ferrous material would improve conditions enough to justify its additional cost—the labor cost in replacement would still be an important factor. The change here might be to cement-lined pipe, or probably better still to wood-stave or tile. Other conditions completely upset this picture. Experience is always the best teacher.

Cooling-water systems vary widely in layout, depending on the availability of large quantities of water. A large diesel-plant cooling system is illustrated



For Oil

THE principal problems of power-plant oil piping are two: hazard from oil fires and difficulty of maintaining tight joints.

Specific requirements for pipe conveying oil under pressure are detailed in the Tentative American Standard Code for Pressure Piping.

In central stations, oil-fire hazard has been the subject of study for several years. Many specific design recommendations have resulted which are applicable to oil piping in any plant.

Storage of lubricating oil should be away from the governor end of turbines where hot steam piping is located. Some plants have constructed fireproof rooms in a relatively remote part of the plant.

Steel piping with welded joints or with companion flanges backwelded is preferred to cast-iron pipe or threaded joints.

Some turbine lubricating-oil piping systems have been constructed with the high-pressure oil-supply line entirely inside and surrounded by the low-pressure return lines.

Non-inflammable substitutes for oil have been successful for hydraulic-governor operating fluids and for other services where lubricating qualities are not required.

Synthetic rubber substitutes have been found satisfactory as gasket material for oil lines.

Sprinkler spray heads and hose nozzles are available which have demonstrated a remarkable ability to put out blazing oil fires with water.

For small fuel-oil piping under moderate pressure, copper tubing with compression or soldered fittings is in general use. Brass pipe with threaded joints brazed for tightness is also satisfactory.

When cast-iron pipe is used for oil lines, allowance must be made for water hammer when determining pipe thickness. Pipe must stand four times service pressure and be tested in place at twice service pressure.

Non-rising-stem valves should be equipped with indicators to show position of gates or disks. Cocks are permissible and are satisfactory for most applications where simple stop valves are required.

Oil-piping connections to tanks and equipment which may be isolated from operating units and entered by men for cleaning or repairs should have double valves and bleeders or else be so arranged that they can be disconnected or blind-flanged.

Welding fittings have different center-to-face and over-all dimensions from flanged fittings, and proper allowance should be made on drawings.

American Petroleum Institute specifications for line-pipe thread may be used for oil lines instead of Standard pipe thread. The threaded section is longer and affords better contact, and therefore a tighter joint.

Heavier flanges are required at the ends of pipe bends subject to expansion strains than for the remainder of the pipe line.

Gaskets should be as thin as the machined surfaces of the flange faces will permit to reduce hazard of blowing out.

Particular attention should be given to the support of oil lines which are usually small and represent a hazard out of proportion to their size. When hangers are located so that they might be destroyed by an oil fire, they should be protected to eliminate the chance of their failure with consequent increase of oil supply to the fire.

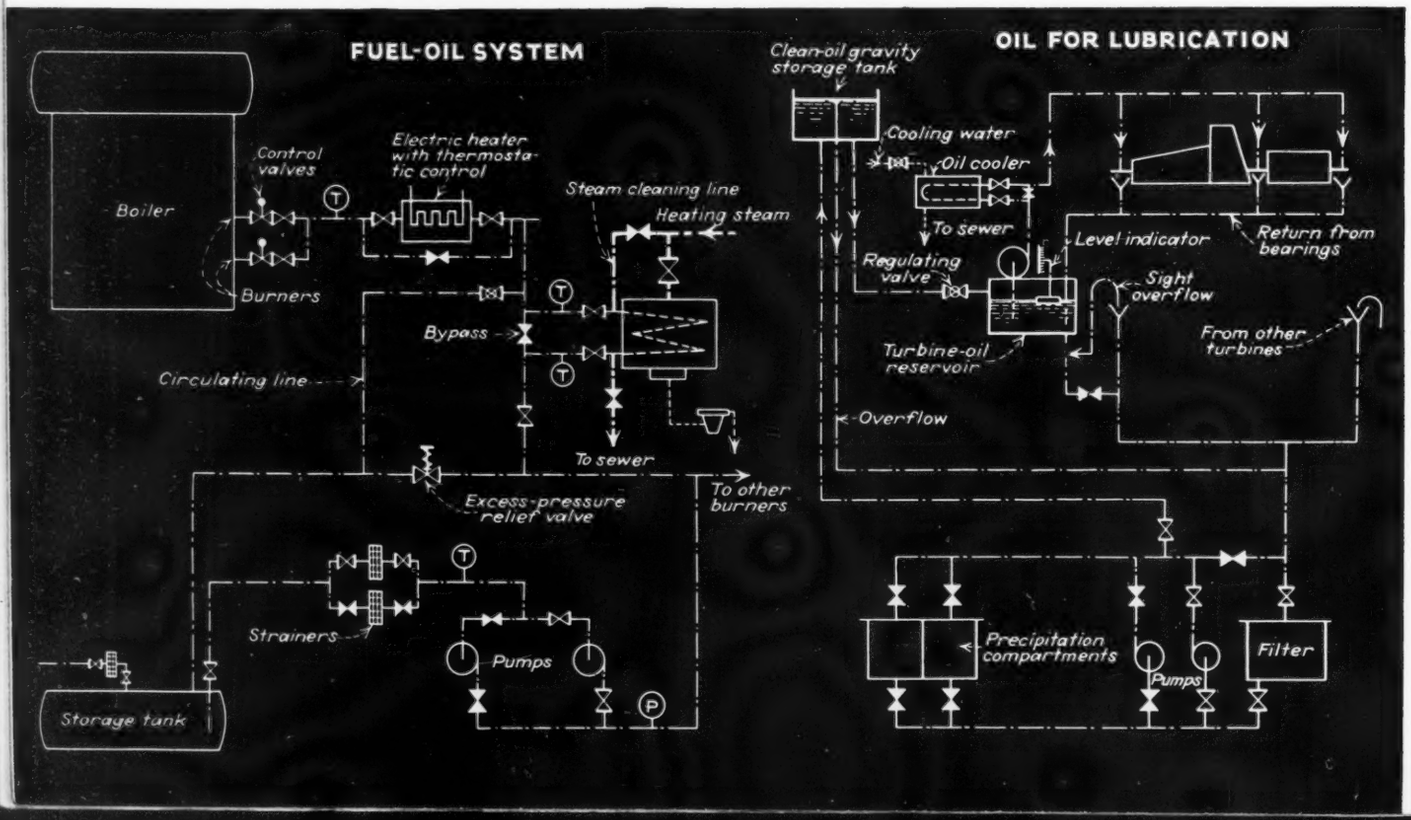
Insulation on oil lines should be protected with a fire-resistant covering of considerable mechanical strength to resist destruction by water from a fire hose.

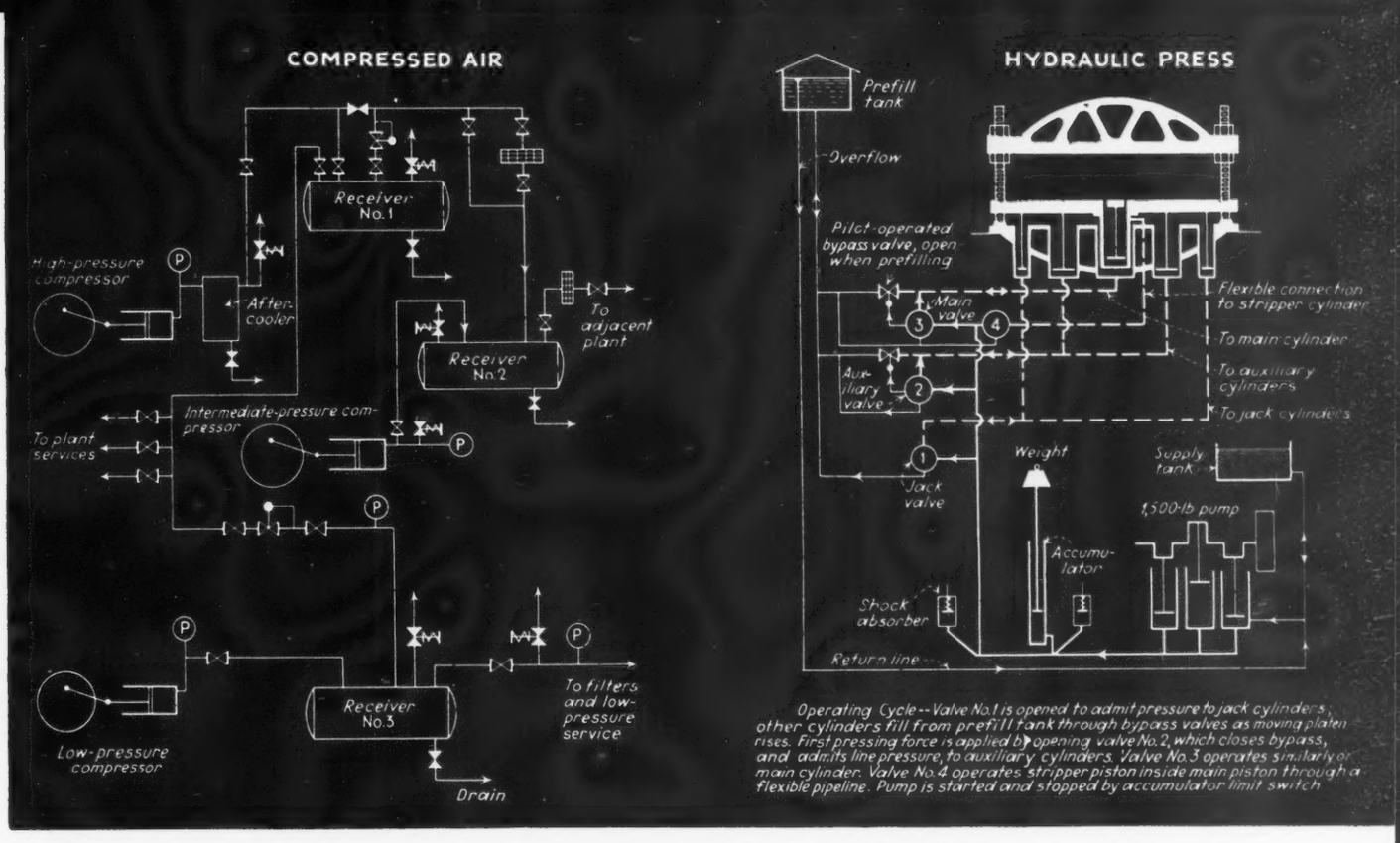
Diesel lubricating systems are usually separate for each engine without interconnection. This guards against accidental drainage. Operating pressure of 10 to 50 lb is maintained by an individual oil pump for each diesel. A relief valve bypasses excess oil.

When diesel lubricating-oil pressure fails or cooling-water outlet temperature rises, fuel-oil supply is cut off by an automatic safety stop valve.

For continuous diesel lube-oil purifying systems served by a single centrifuge, inlet and discharge valves to the crankcase of each engine are interlocked to prevent accidental draining. Cocks are specially designed for this service with geared operating wheels.

Oil systems vary with plant, prime mover, even with oil. Here are shown two: fuel-oil piping with preheaters from storage tank to burners, and a lubricating-oil sedimentation and filter system




COMPRESSED AIR
Receiver No.1
High-pressure compressor
After-cooler
To adjacent plant
Receiver No.2
Intermediate-pressure compressor
To plant services
Receiver No.3
To filters and low-pressure service
Low-pressure compressor
Drain
HYDRAULIC PRESS
Prefill tank
Overflow
Pilot-operated bypass valve, open when prefilling
Main valve
Flexible connection to stripper cylinder
To main cylinder
To auxiliary cylinders
To jack cylinders
Auxiliary valve
Jack valve
Weight
Supply tank
1,500-lb pump
Accumulator
Shock absorber
Return line
Operating Cycle--Valve No.1 is opened to admit pressure to jack cylinders; other cylinders fill from prefill tank through bypass valves as moving platen rises. First pressing force is applied by opening valve No.2, which closes bypass, and admits line pressure, to auxiliary cylinders. Valve No.3 operates similarly on main cylinder. Valve No.4 operates stripper piston inside main piston through a flexible pipeline. Pump is started and stopped by accumulator limit switch

A 3-pressure compressed-air system with separate receivers illustrates air-piping connections. Hydraulic-press system requires forged fittings and special high-pressure 3- and 4-way control valves. Stop valves are normally provided on supply tank and pump to permit repair without draining the system

For Compressed Air

AIR-PIPING systems above 30-lb pressure are governed by the American Tentative Standard Code for Pressure Piping.

Neither corrosion nor erosion is a serious factor in compressed-air piping; tightness of joints and valves is essential since a number of small individual leaks result in large power waste.

Adequate drainage connections are required at receivers and low points in the lines, as the air carries appreciable quantities of both water and oil which condense in the pipe.

Relief valves are required for the protection of the compressor, coolers and piping system. These must be installed in such a way that it is impossible for a careless operator to build up dangerous pressures by closing stop valves or from reducing valves sticking open.

Compressed-air lines should be protected against freezing.

Intake piping to compressors should be provided with fine-screen filters to ensure a clean supply of air and avoid excessive cylinder wear. Oil supply should also be passed through a strainer.

Flexible hose for use in connection with compressed-air systems should have abrasion-resistant covering to protect against cutting by sharp objects usually present on a construction job.

No hose other than that specifically designed for compressed-air service should ever be used with high-pressure air.

Vent and drain outlets from compressed-air systems should be directed against the floor or otherwise installed so that they cannot impinge on a man's skin. Serious trouble can result from the direct contact of a high-pressure air stream.

For Hydraulic

PIPING systems for hydraulic pressure are specially designed for each application. The fluid is usually either water or oil and is kept at or near room temperature.

Pressures ranging up to 3,000 lb require thick-walled seamless-steel pipe with fittings forged and machined from solid. Larger sizes of pipe are also machined from forged billets.

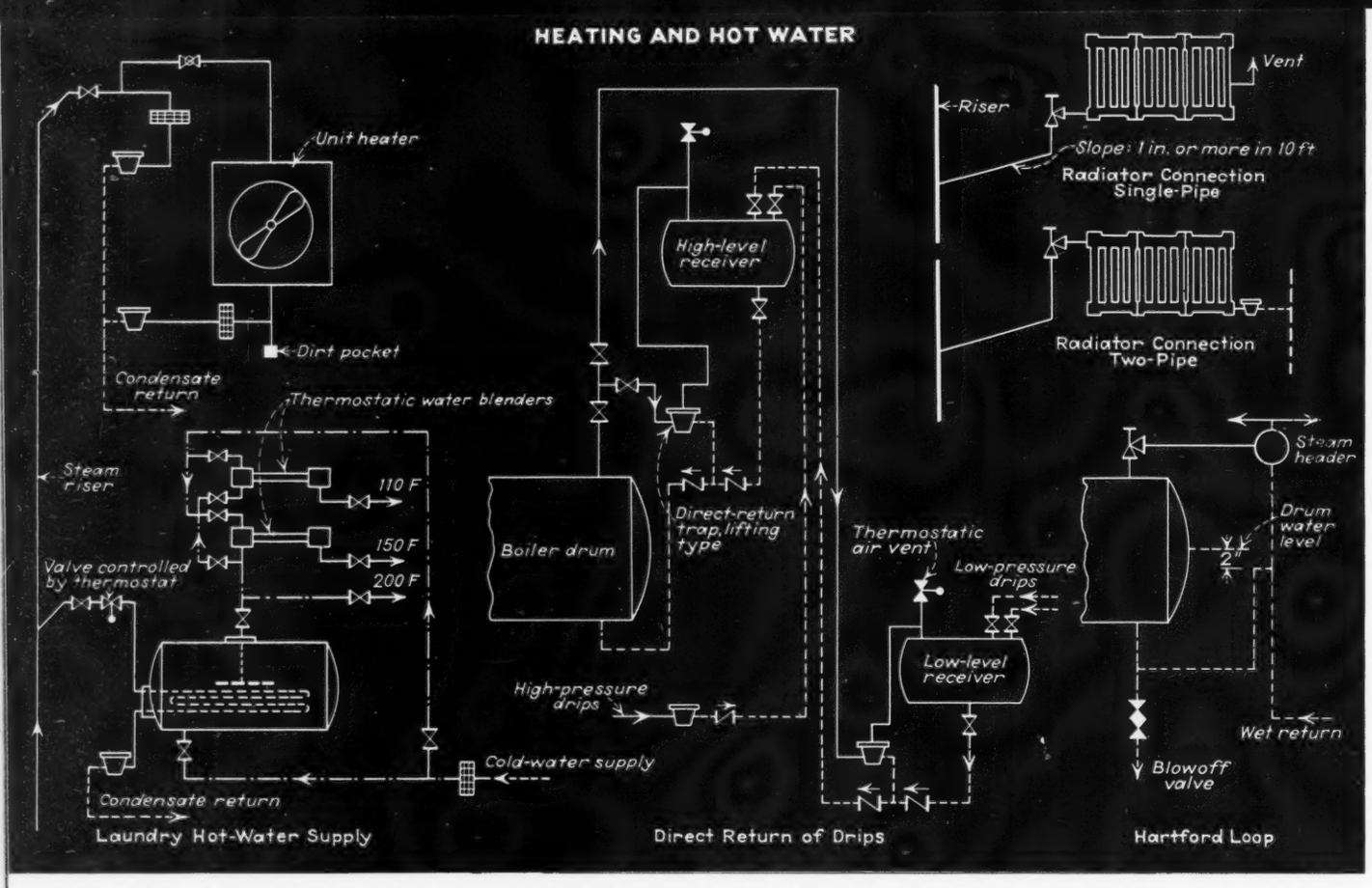
Accumulators for storage of fluid under high pressure cause pressure surges like water hammer when valves are closed. Spring-loaded shock absorbers are required at several points in the system to take up shocks. Restrictions or chokes are often used in the accumulator connection to reduce the maximum rate of speed at which the accumulator can fall.

Valves are specially designed for service, balanced against the pressure or pilot-operated.

Hydraulic pipe lines are kept as short as possible because of the high cost of pipe and fittings.

Protection against excessive pressure is afforded hydraulic systems supplied by piston or gear pumps by a relief valve connected directly between the discharge and suction lines of the pump.

Many systems are filled with water in summer and a light non-freezing oil in winter—requiring drains, refill points and oil-storage facilities.



Correct layout of heating and hot-water systems avoids expensive repair bills. A wide variety of standard systems are available, of which only unusual elements are shown above

For Heating

LOW-PRESSURE heating steam involves no serious safety hazard, and in most localities is subject only to regulations of the local building code.

The principal problems of heating-system piping are drainage, expansion, and control of heat supplied various parts of the building during widely differing weather conditions.

The annual *Guide* of the American Society of Heating & Ventilating Engineers contains a digest of good heating practice.

Pipe material should be selected which will last the life of the building. Except under unusual circumstances, ordinary lap- or butt-welded pipe is satisfactory for steam lines. For hot-water piping, wrought iron, brass, copper and cast-iron pipe have their legitimate places.

Heating-steam piping should be zoned, or other control provided so that differences in wind, sun and occupancy conditions can be cared for. Control provision for night conditions is sometimes overlooked; savings in steam cost justify attention to night conditions.

Expansion amounts to about 1½ in. per 100 ft. Headers and risers must be able to expand without straining the fittings. Radiator branches should be long enough to permit vertical movement of the riser.

Pockets should be avoided in both supply and return lines. Mains and branches should be graded 1 in. in 20 ft when condensate flows in the same direction as the steam, twice this gradient when flows oppose.

Low points should be trapped and provided with dirt pockets.

Sizes of risers and return lines are best determined from experience. Capacities are given in handbooks and the ASH&VE *Guide*.

Reducing valves should be bypassed to allow repairs without shutdown of the heating system. Relief valves on the low-pressure side are required to prevent dangerous pressures.

Valves should be placed in the highest point in the branch from riser to radiator so that condensate will not collect above the valve and cause water hammer when the steam is turned on.

Risers should connect to the top of mains or at 45 deg, otherwise a pocket is formed which will collect condensate.

A valve should be placed in each riser near the main so the individual risers may be shut off at night or for repairs.

Where a vacuum pump is used, a bypass should be provided so that the system can be operated under pressure in case of pump trouble.

Provision for thermostatic control of hot-water temperature to building-supply systems is necessary to avoid burns (showers and wash water) if the heating is done by steam.

Corrosion characteristics of heated water may be entirely different from those of the same water when cold. Materials which have given satisfaction in cold-water service may fail in hot-water lines. Occasionally the reverse is true. Before specifying material for a hot-water system, check the experience of other engineers in the neighborhood if you have not had previous experience with the same water.

Closed tanks in which water is heated sometimes suffer from the corrosive effects of dissolved gas given off by the water as its temperature is raised.

Some city-water supplies are scale-forming when heated. Heating coils should then be arranged for easy cleaning and either duplicate installations provided with the necessary bypass connections, or an emergency supply made available.

For Refrigeration

PIPING SYSTEMS containing refrigerants of a toxic nature such as ammonia or sulphur dioxide are regulated by local building codes. Carbon-dioxide and water-vapor air-conditioning systems are allowed greater freedom of design. Certain other refrigerants, notably Freon, are entirely non-toxic and non-inflammable under normal circumstances and require protection only in case of fire which causes partial decomposition.

Piping rarely corrodes from the action of refrigerants, iron, steel, copper and brass being unaffected by all commercial refrigerants when pure. Sulphur dioxide and ammonia, when in contact with water, are quite corrosive, and the remedy is usually found in maintaining purity of refrigerant.

Tightness of joints is one of the principal pipe problems. Unions and fittings are special "ammonia" type with a lead gasket. Compression fittings and soldered joints are being used to an increasing extent, particularly for smaller installations.

A minimum number of valves is used in refrigerant piping; tightness of stem packing is essential to prevent loss of refrigerant or infiltration of air. Valves in refrigerant lines should be of such design that it is impossible to remove the stem assembly by mistake in repacking. This would release dangerous quantities of gas.

It is important that insulation for refrigerant and brine piping be absolutely airtight to prevent moisture from entering and freezing beneath the insulation. This is accomplished by applying insulation in several layers, with a sealing compound between layers.

In laying out air-conditioning systems, balance the cost of piping against cost of ductwork in determining whether to use a central or unit system. Since piping cost is a relatively large factor, expense can be minimized by design of the entire system as a coordinated unit.

Brine, when contaminated with ammonia, is highly corrosive even to materials suitable to brine service. Provision for sampling brine should be included in the system, together with connections for introducing new brine with minimum delay.

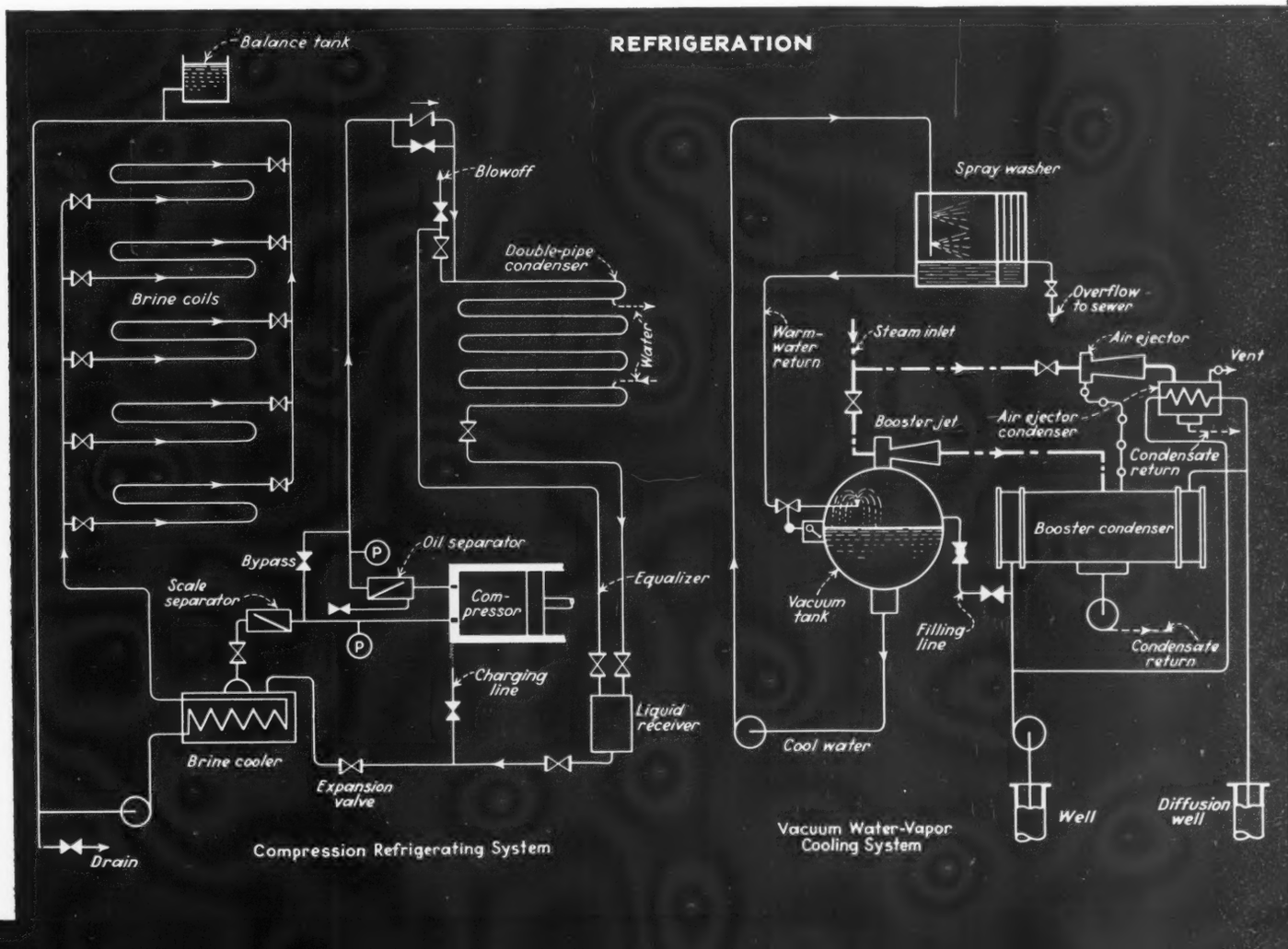
Cooling coils that come in contact with beer or foodstuffs must be of a material that will not react chemically and contaminate the product as well as be resistant to the brine or refrigerant. While copper is satisfactory in many cases, stainless steel and other special pipe materials are available to suit individual cases.

Red brass is recommended by many engineers as giving long service in air-conditioning-system piping.

Wrought iron, copper-bearing steel, copper molybdenum iron and less frequent cast iron, because of cost, are the most common materials for brine piping. All are used extensively in indoor skating rinks and other large-scale applications of brine pipe. Stainless steel is popular in food plants.

Refrigerant leaks can usually be detected quickly by odor. In ammonia lines they can be located by following along the pipe with an open container of strong hydrochloric (muriatic) acid or a burning sulphur candle. The fumes from either form a dense white cloud when in contact with ammonia. For sulphur dioxide, reverse the procedure and test with strong ammonia water. Wet litmus paper or phenolphthalein solution will turn blue when affected by ammonia, reddish from sulphur dioxide.

Refrigeration systems require special piping and insulation. Air conditioning requires economic balance between piping and ductwork



Instrument Piping

ON THE ACCURACY and reliability of instruments depends both economy and safety in operation. And an instrument is no better than its piping. Yet instrument piping must get eleventh-hour consideration, because its location cannot be determined until equipment and other piping is fixed.

Instrument location must be chosen to insure visibility and access for adjustment. Gage lines are small-size pipe and there are usually many individual lines. External support providing stiffness is necessary. Where many lines can be run alongside a column or wall, all can be supported by spacers from a single support bracket. Take care that instrument piping is out of the way of passing men and materials. Small piping should never cross an open area unless guarded.

Brass pipe or copper tubing with compression fittings are well suited for instrument connections where temperature and pressure conditions permit. Soft copper tubing can be bent to suit field conditions without working drawings, an advantage that means a time saving near the end of the job. Brass and copper too are less susceptible to corrosion from the traces of sulphur dioxide in boiler rooms.

Valves should be physically small in copper-tubing lines so that only small wrenches are required to take up on gland nuts. With heavy valves, tubing gets badly bent. Valves should isolate instrument lines normally carrying pressure. Lines to draft gages collect soot and provision should be made for cleaning.

System Identification

IN CENTRAL STATIONS, piping systems are exceedingly complex but handle relatively few materials. The maze of interconnection between steam headers, water-supply circuits, boiler-feed piping and drain connections would be almost unintelligible to a stranger, but is well-known to operators after a period of experience. Modern industrial plants, on the other hand, represent piping systems transporting many different fluids; some of these may be dangerous, others valuable. System identification presents a different problem in each type of plant.

Many older central stations still have all high-pressure steam piping painted one solid color, exhaust steam another color, and so on. The trend in newer stations with relatively simpler piping systems is to paint all pipe a uniform neutral color, gray or aluminum (uninsulated pipe may be black) and to rely on line diagrams posted in frames at suitable points for an understanding of operation.

One method now in favor for power plants is to label each valve with a brass tag. A convenient tag is a lettered or stamped disk secured by the handwheel lock nut. For motor-operated valves, identification is usually painted on the control station and signal lights indicate valve position.

Where some system of identification is desirable for power plants, an ASME committee has suggested a color scheme to be painted on flanges, fittings or in small panels:

High-pressure steam	White
Exhaust steam	Buff
Condensate, fresh water	Blue
Boiler feed	Blue and white
Salt water, raw water	Green
Oil	Bronze
Fuel oil	Black
Air	Gray
City gas	Aluminum
Gas for engines	Red
Refrigerant	Green and white
Electric conduit	Red and black

For general industrial piping, the American Engineering Standards Committee (Report A-13) lists five general classes of piping:

Class F	Fire	Red
Class D	Dangerous	Yellow or orange
Class S	Safe, cheap	Green, white, black gray or aluminum
Class P	Protective	Bright blue
Class V	Valuable	Purple

Both the above systems intend that the run of piping shall be solid color to suit plant conditions, with only flanges or bands painted identifying colors. Whether or not color bands are used, lines may be identified by stenciled markings in large readable letters or valve tags.

Insulation

SO MUCH has already been said concerning the economic justification of proper insulation for piping conveying hot or cold fluids that it is unnecessary to discuss here the large losses resulting from bare pipes. The selection of proper insulation material and form from among the many varieties offered, and the proper thickness to be applied is nearly as important as proper selection of pipe material.

Selection of material is made only to suit the temperature of the metal wall and the conditions surrounding the pipe as they determine such factors as moisture resistance, appearance and external coating. The most used and generally most satisfactory insulating material is molded 85% magnesia, a non-proprietary product of several manufacturers. However, magnesia gradually decomposes at temperatures above about 600 F and for higher temperatures manufacturers have developed individual products, many of which have already proved satisfactory in several years experience. For temperatures over 600 F, it is customary to use a layer of high-temperature insulation just thick enough to keep the outer layer of 85% magnesia below its maximum working temperature. An idea of proper average thickness can be obtained from the table.

It is easy to tell how to calculate the economical thickness for insulation, not so easy to apply the simple theory to actual cases. Heat loss through pipe and insulation for steam lines can be calculated with sufficient accuracy from heat-transfer coefficients found in handbooks or manufacturers' catalogs. For 85% magnesia, the heat loss is about 0.4 Btu per sqft per deg F per in. of thickness. The cost of producing the heat loss is then determined from the boiler efficiency in terms of pounds of coal per year or in dollars per year. Finding the cost of increased thickness of insulation to balance against the decreased heat loss requires skilled, unbiased estimating of true differences in cost.

APPROXIMATE INSULATION THICKNESS

Pipe Size	Temperature of Pipe Surface; F: −60 to −20	−20 to −10	−10 to +5	+5 to +25	25 to 50	50 to 70	70 to 300	300 to 450	450 to 600	600 to 700 HT	600 to 700 Mag	700 to 800 HT	700 to 800 Mag	800 to 900 HT	800 to 900 Mag
	Standard Hair Felt						85% Magnesia								
Under 2 in.	5	4	3	3	2	1	¾	1½	2	2	...	2	...	2	...
2 to 3½ in.	5	4	4	3	2	1	1¼	1½	2	1½	1½	1½	2	2	2
4 to 6 in.	6	5	4	3	2	1	1½	2	2¼	1½	1½	1½	2	2	2
7 in. and over	6	5	4	3	2	1	1¼	2	2½	1½	2	2	2	2½	2

HT = Inner layer of special molded HT insulation

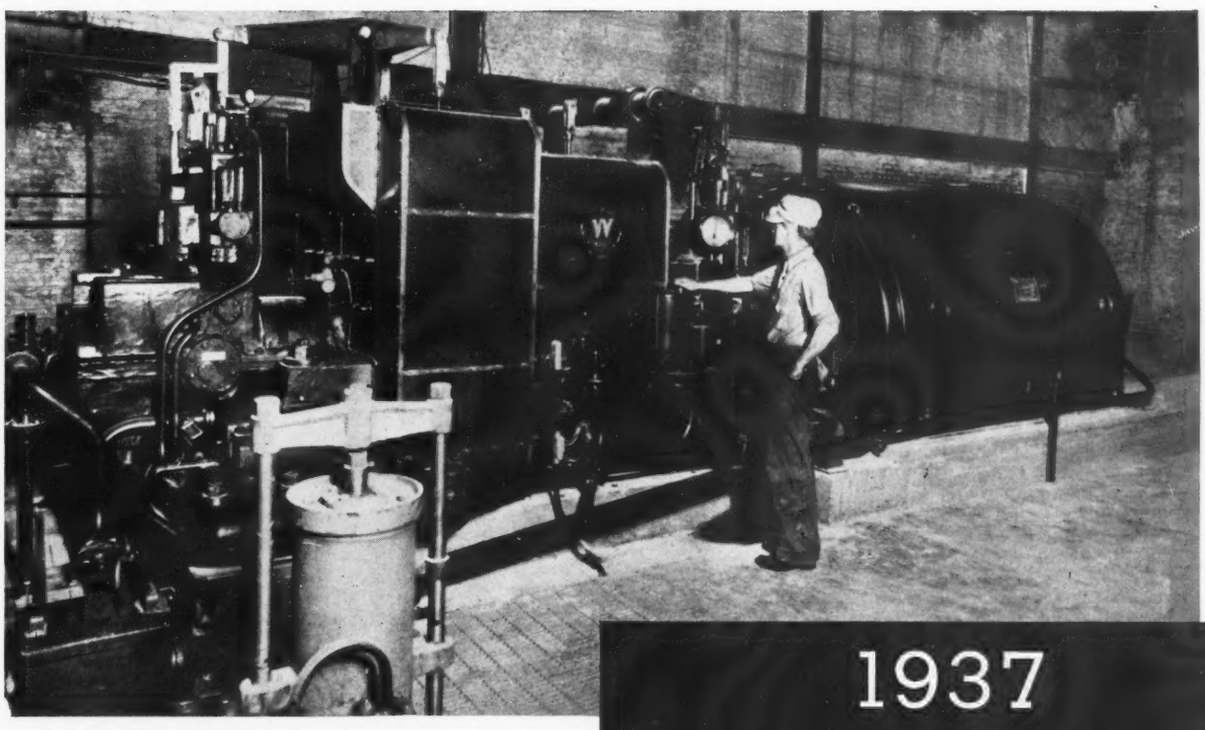


Fig. 1—This 5000-kw backpressure turbine, typical of 1937's most advanced industrial practice, bleeds at 400 lb. Speed, 3600 rpm. Throttle steam, 825 lb, 750 F

1937 OUTSTANDING POWER YEAR

LOADS GROW

IN MANY RESPECTS 1937 has been an outstanding power year (see "Milestones" on this page).

Consider loads, for example. The 1929 total output of utility plants was 97.4 billion kwhr. The 1936 figure was 113.6 billion. In spite of the year-end business recession, the 1937 total will be about 124 billions. Construction of central stations has seemed active, at least in terms of the depression hibernation, but it's only a drop in the bucket compared with real needs based on cumulative and present load growth.

Mid-September *Power* asked "How about a power shortage" around the end of 1938?- No facts or logic insuring the contrary have been received. From 1920 to 1929 the average kilowatt of capacity turned out 3000 kwhr yearly. Today it's about 3400 kwhr.

If yearly percentage load growth for the next few years equals that of the 1920-29 era we must install new capacity 50% faster than during 1926-29 just to hold our own on a questionable 3500-kwhr basis. A serious jam of equipment manufacturing facilities threatens for 1938. Perhaps local power shortages next winter.

MILESTONES

1—Output 124 billion kwhr
2—Tops at their peak
3—2400-lb plant announced
4—Ford boiler delivers 1,040,000 lb per hr
5—900-lb steam with 100% makeup
6—Hydrogen cooling advances
7—Condensing top under construction
8—Guffey-Vinson coal act
9—Hydro output 46 billion kwhr
10—Mass production lowers diesel cost
11—Big mercury-arc rectifiers for industry
12—Combination Carrene-ammonia refrigeration
13—Spectacular advance of air conditioning
14—400,000-hp pumping installation
15—Welding triumphs

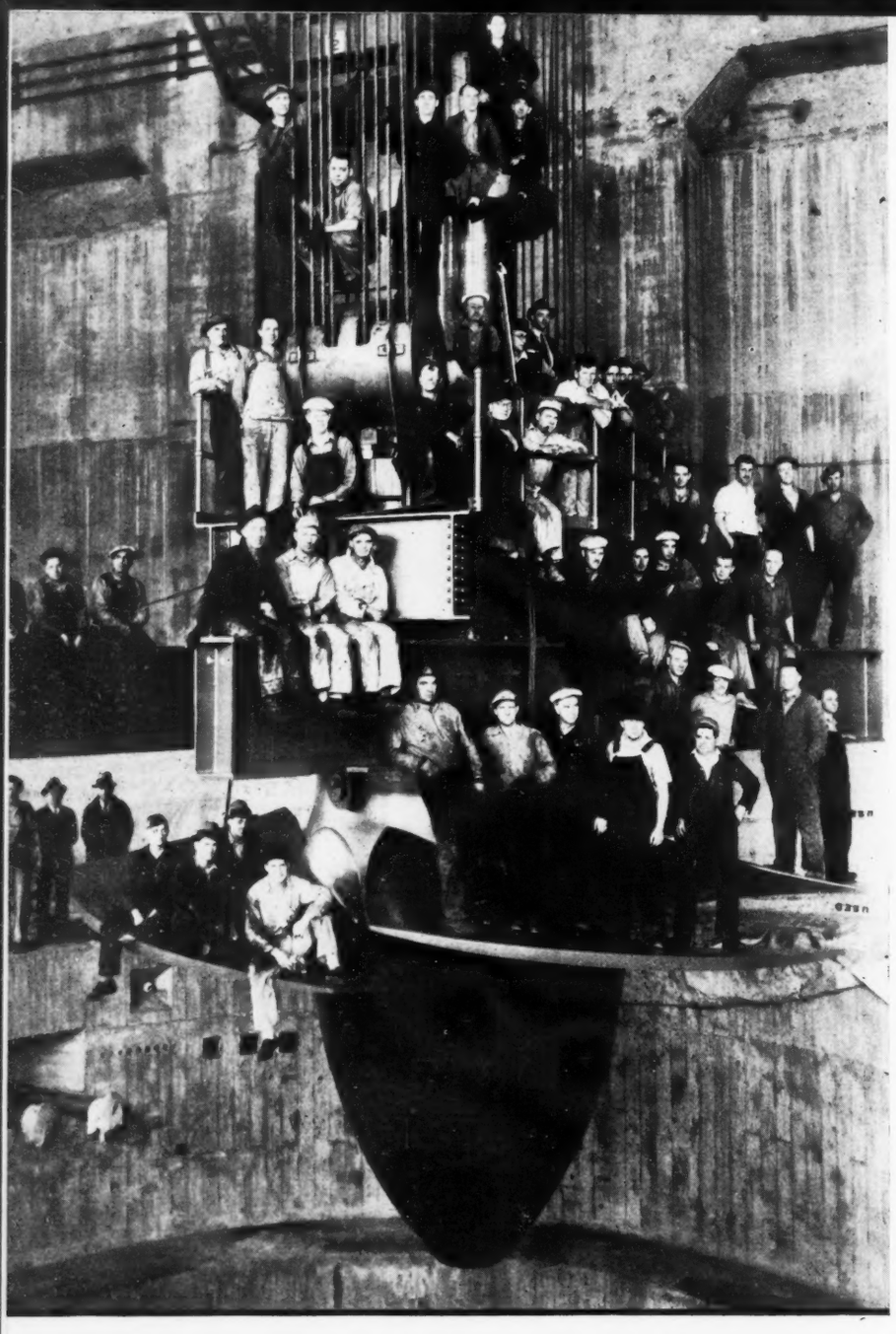


Fig. 2—One of two 66,000-hp Kaplan runners at Bonneville plant. Diameter, 23 ft, 4 in. Weight, 275,000 lb

STEAM FLOURISHES

Since the entire Mid-September number of *Power* reviewed recent steam-plant design advances, the present review will cover only high points.

Plant Trends

Measured by orders, the "topping tide" in central stations rose rapidly in 1936, reached high water about midyear of 1937, and is now ebbing. From now on, orders for straight condensing units must increase in relation to tops; topping ends itself by eliminating its own prospects.

Pulverized coal dominated in new central-station installations. Slag-tap furnaces were preferred for large and base-load units. Practically every installation included both economizer and air heater. Many urban plants arranged to remove flyash by wet or dry cleaning. Except for boiler-feed pumps most auxiliaries were motor driven.

Industrial power loads rose faster than heating and process loads. This trend favors higher pressures. Stokers held nearly even with pulverized coal in large industrials and predominated in smaller installations. The majority of new units (eliminating the very small) used economizers or air heaters or both. Automatic control moved ahead.

High Pressures

In general, steam pressures in the United States kept under the 1400-lb ceiling, while temperatures crept up past 900 F. Announcement was made, however, of a 57,500-kw, 2400-lb, 940-F extension for the Twin Branch Plant of the Indiana & Michigan Electric Company. Planned to operate in 1939, this addition will be a condensing unit. Cycle is "straight regenerative reheat" with variable crossover pressure (max. 450 lb). The 22,500-kw HP turbine will drive hydrogen-cooled generator at 3600 rpm, but LP machine is 1800 rpm. Boiler will deliver 550,000 lb per hr. Integral reheater will heat 450,000 lb per hr to 850 or 900 F. Furnace is slag bottom.

Boilers

Ford's spectacular Rouge plant set another record; one of its boilers delivered 1,040,000 lb of steam per hr at 1250 lb and 900 F, highest known output for these conditions. This boiler (installed in 1936) serves a 110,000-kw turbine.

Europe moved ahead with its forced-circulation boilers. American designers kept an eye on these units but continued to sell natural-circulation units exclusively. America's first Velox boiler went into operation in an oil refinery.

Feedwater treatment technique advanced steadily. A year's operation at Weirton Steel, announced in 1937, definitely proves that a plant can operate with 100% makeup and at 900 lb without harmful carryover. Weirton setup includes lime-and-soda softening, filtration, deaeration, secondary phosphate treatment, steam washing in drum and continuous blowdown with heat exchange. Similar precautions have yielded 650-lb steam of satisfactory purity in Station No. 3, Rochester (NY) Gas & Electric Co.

Turbines and Engines

The Logan turbine, Appalachian Electric Power Co, was one of the year's most notable topping units. Data: 40,000 kw, 3,600 rpm, 1250 lb, 925 F, hydrogen-cooled generator. At hot end, machine is double-shell, concentric, with 7th-stage pressure maintained between shells. Inner shell, supported along vertical and horizontal center lines, expands equally and symmetrically outward in all directions, and remains coaxial. With such designs tested, builders stand ready to deliver turbines for any required pressure and temperature.

The "condensing top" was a new development of 1937. This is a bleeder, condensing, HP turbine supplying bled steam to the throttle of an existing LP condensing turbine. The unit is a cross between a straight

top and a condensing unit, and claims some of the advantages of each. Such a turbine, now under construction, generates 30,000 kw of high-economy power as a condensing unit, or (alternately) can serve a 30,000-kw LP unit to generate a total of 50,000 kw of good-economy power.

In Europe, far more than in America, the possibilities of the high-pressure steam engine receive attention. High throttle pressure, high back-pressure and small capacity all favor the steam engine over the turbine. This would appear to open a definite field for the super-pressure steam engine for generating byproduct power in industrial plants of moderate size.

At the Leipzig Fair last spring, M.A.N. exhibited a 40-hp, 1,000-rpm uniflow "steamotor" operating at 480 to 570 F. America's chief interest in high-pressure steam engines centered in high-speed, multiple-cylinder, multiple-unit steam motors for locomotives—a possible answer to diesel competition.

Fuel and Smoke

During the year the Guffey-Vinson bituminous coal act went into operation, the year's most important fuel event. In essence the act directs the Bituminous Coal Commission to fix minimum f.o.b. mine prices for each locality and each classification of coal. The setting of minimum prices, plus the effect of the recent freight increase on coal, should substantially increase the cost of coal to the consumer, particularly the industrial consumer who has benefited most in the past by competition in price.

A large proportion of new central stations and big industrial-power installations provide for cinder and dust removal. Few American plants, however, attempt removal of sulphur compounds. England has gone in for far greater sulphur removal.

MORE ENERGY FROM WATER

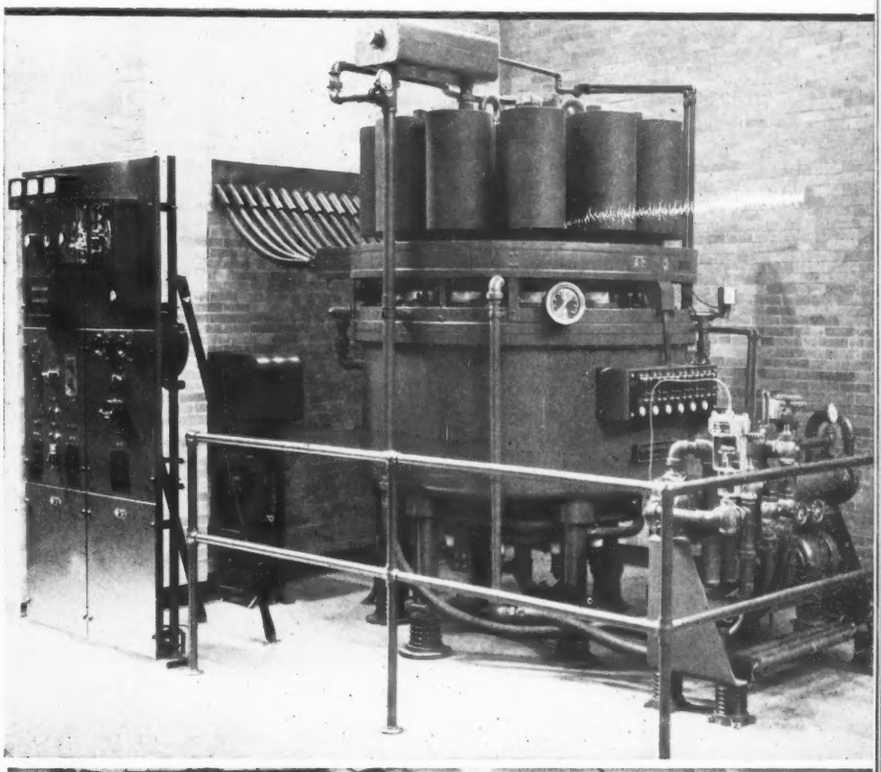
Even though waterpower in the United States during 1937 continued to be plagued with floods and droughts, it supplied approximately 46 billion kwhr, compared to 41 billion last year and 39.5 billion in 1935. According to the U. S. Geological Survey, total capacity installed in waterpower plants increased from 16,079,407 hp as of Jan 1, 1936, to 17,119,610 Jan 1, 1937, or a gain of 1,040,103 hp.

Much of this increased capacity is accounted for by large projects going into service (completion of which was held up during the depression) and by large Federal Government projects. These included Diablo of the city of Seattle, Wash., Hawks Nest (WVa.) project of the New Kanawha Power Co, and Boulder Dam, Norris Dam and Joe Wheeler Dam of the Federal Government.

This year new capacity will probably not exceed 500,000 hp, including two 115,000-hp units in Boulder Dam plant. This makes four of that capacity in operation and one of 55,000 hp. Two units ordered last year for 1938 operation, and two contracted for this year for 1939 operation, will give this plant an installed capacity of 982,000 hp, including two service units. Boulder Dam is laid out for 1,835,000 hp total.

Bonneville

The Bonneville units on the Columbia River will start operation in 1938. This plant has two 66,000-hp Kaplan wheels, the largest of this type ever built. The Bonneville units are equipped with the largest self-contained governing equipment in the



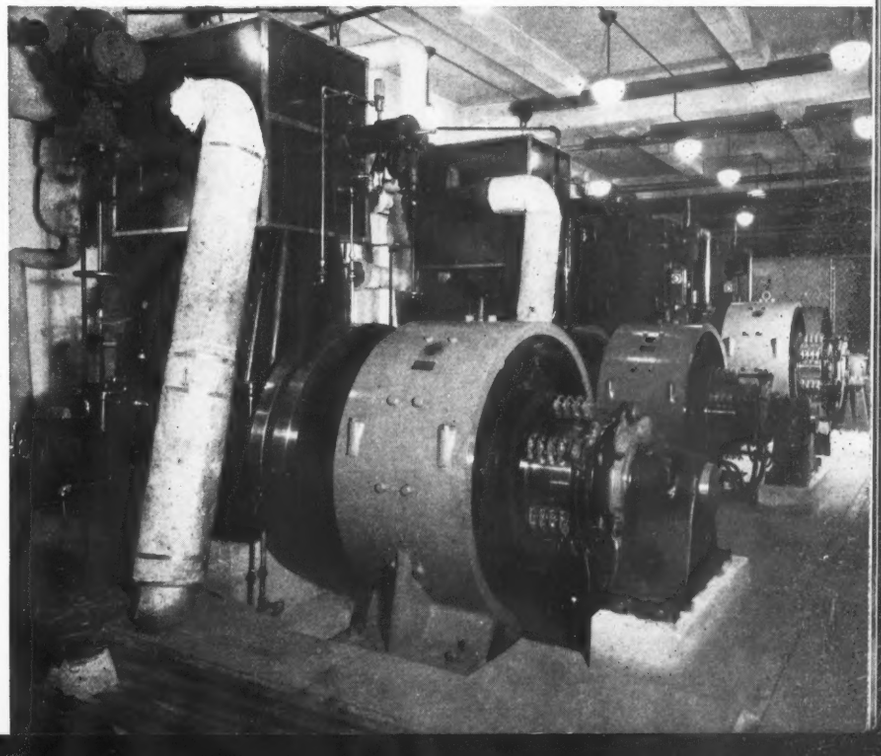


Fig. 4—This 1,000-kw, 250-V, grid-controlled mercury-arc rectifier was the first used for power supply in any American steel mill. Fig. 5—Steam engines and diesels work together in Empire Trust Building, New York.

How would YOU like to make

FERTILIZER PLANT INCREASES EVAPORATION FROM 7½ LBS. TO 10 LBS.—SAVES ⅓ OF COAL BILL

by installing Riley-Jones Stokers

"We increased our evaporation from 7½ pounds to 10 pounds of steam per pound of coal, a saving of 33⅓%."

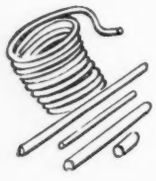
Darling & Company,
Millenbach Plant, Detroit, Mich.

COLLEGE SAVES 26% OVER PREVIOUS FUEL COSTS

by installing Riley-Jones Stokers

"I know you will be interested to learn that our savings in fuel cost last year was 26% over the previous year."

Concordia College, Ft. Wayne, Ind.



COPPER AND BRASS PLANT PAYS FOR STOKER IN 7 MONTHS

by installing Riley-Jones Stokers

"In our particular case, due to the inefficient type of stokers we had we showed a tremendous saving in our coal bill. In fact, we paid for the Jones Stokers in some seven months in our coal savings."

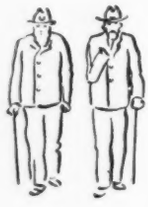
Eastwood-Nealley Corp., Belleville, N. J.

APARTMENT BUILDING REDUCES FUEL COSTS FROM $4000 TO $1500

by installing Riley-Jones Stokers

"It formerly cost us about $4000 per year to heat and furnish hot water to the Winston Churchill Apartments, using oil at 4⅛ cents per gallon With the Riley-Jones Stoker we can furnish heat and hot water at $1500 per year"

Winston Churchill Apartments, St. Louis, Mo.



SOLDIERS' HOME BURNS ONLY HALF AS MUCH COAL AS FORMERLY

by installing Riley-Jones Stokers

"We are very pleased with our stokers and already have proven that we are burning only about half the coal we formerly consumed."

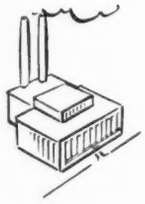
South Dakota State Soldiers' Home, Hot Springs, S. D.

BANK SAVES OVER 50% OF FUEL BILL—$980.38

by installing Riley-Jones Stokers

"Previous to the installation of our Jones Stoker, we used 285 tons of coke at $6.50 per ton, $1908.25. The first complete year of the stoker operation we used 274¼ tons of coal at $3.40 per ton, $927.87, saving $980.38 or over 50%."

The Second National Bank, Warren, Ohio

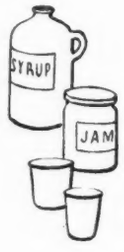


PUBLIC UTILITY SAVES FROM 20 TO 25% IN COAL

by installing Riley-Jones Stokers

"This stoker has been very dependable in every way and as to saving over hand firing, I would say they would save from 20% to 25%."

Municipal Light & Water Plant, Reading, Ohio

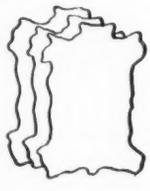


PRESERVING PLANT SAVES 40% OF COAL BILL

by installing Riley-Jones Stokers

"It has shown us an actual saving of 40% in the amount of coal used and we are now using screenings which show an additional saving of approximately 75 cents per ton over the grade of coal we had to use when hand firing"

American Syrup & Preserving Co., Nashville, Tenn.



TANNING PLANT BOOSTS EVAPORATION FROM 6⅓ LBS. TO 9.3 LBS.—SAVING ⅓

by installing Riley-Jones Stokers

"Under hand firing method we evaporated only about 6⅓ pounds of water per pound of coal. With the Jones Stoker we are getting 9.3 pounds of evaporation per pound of coal."

S. B. Foot Tanning Co., Red Wing, Minn.

CLEANER & DYER CUTS COAL BILL IN HALF

by installing Riley-Jones Stokers

"We have cut our monthly coal bill in half."

McClaskey, Inc., Wheeling, W. Va.

YOU CAN MAKE SIMILAR SAVINGS

Riley-Jones Side Dump Stokers are manufactured in sizes for installation under boilers for 25 H. P. to 600 H. P.—as single or twin retort stokers with moving or stationary combustion grates and with mechanical hydraulic or steam operated rams. Because of the many outstanding features of the Riley-Jones Stoker, you should investigate them.

RILEY

STOKER CORPORATION - WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore St. Louis Cincinnati
Houston Chicago Milwaukee Denver Memphis St. Paul Kansas City Los Angeles Atlanta New Orleans

These Savings in Your Coal Bills

FLORIST EASILY SAVES 35% OF THEIR FUEL BILL
by installing Riley-Jones Stokers

"We can easily save about 35% in our fuel."

McCauslens, Florists, Steubenville, Ohio

SCHOOL REDUCES COAL BILL OVER ⅓ SAVES $549.53
by installing Riley-Jones Stokers

"From September 1, 1928 to June 1, 1929, over school term, we used by hand firing 571 tons of run of mine coal at $2.65 per ton, $1513.15. From September 1, 1929 to June 1, 1930, we used 584 tons of nut, pea and slack at $1.65, $963.60. Saving over ⅓ or $549.53."

Athens City Schools, Athens, Ohio

DAIRY SAVES $2000.00 YEARLY IN COAL BILLS
by installing Riley-Jones Stokers

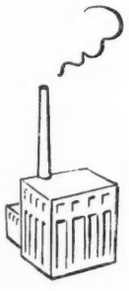
"As near as we can estimate, the saving is approximately $2000.00 yearly in our coal bills."

Lancaster Sanitary Milk Corp., Lancaster, Pa.

SHOE FACTORY SAVES 33⅓%
by replacing existing stokers with Jones

"In regards to fuel saving, would advise that we have been able to reduce the coal bill approximately 33⅓% since installing the Riley-Jones Stoker in place of the — stoker."

Brown Shoe Co., Moberly, Mo.

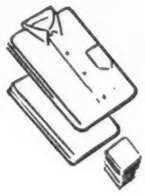


WATER WORKS CUTS COST OF PUMPING FROM $8.50 TO $5.90
by installing Riley-Jones Stokers

"The cost of fuel for handling per million gallons pumped is as follows:

Hand firing	
2.057 tons W. Va. R. & M. coal @ $4.13 =	$8.50
Stoker firing	
1.54 tons W. Va. N.P.S. coal @ $3.83 =	$5.90
Saving	$2.70 = 31.7%"

City Water & Electric Plant, Mishawaka, Ind.



LAUNDRY SAVES 33⅓% CUTS COST FROM 4.8% TO 3.2%
by installing Riley-Jones Stokers

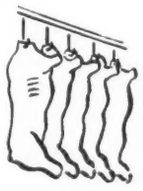
"Our records show that for the three years before we put in the stokers our fuel cost was 4.8% on the amount of our work and for the three years since our fuel cost has been 3.2%."

Oak City Laundry, Raleigh, N. C.

HOSPITAL MAKES SAVING OF $2300 PER YEAR
by installing Riley-Jones Stokers

"We found that we make a saving by the use of stokers. In 1935, we made a saving of about $1800.00 and in 1936 we made a saving of $2300.00."

Butler Hospital, Providence, R. I.



MARKET & STORAGE PLANT SAVES $3749 PAYS FOR STOKER IN FIRST YEAR
by installing Riley-Jones Stokers

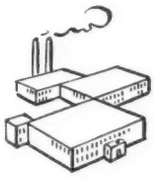
"The saving last year over the previous year's operation amounts to $3749.00. This saving has more than paid for the cost of the installation."

Sheriff St. Market & Storage Co., Cleveland, Ohio

BREWERY REDUCES COAL CONSUMPTION FROM 10 TONS TO 7 TONS A DAY
by installing Riley-Jones Stokers

"With stokers of another manufacture, our average consumption of coal per day was 10 tons. With the Riley-Jones we averaged less than 7 net tons per day."

North American Brewing Co., Brooklyn, N. Y.



MANUFACTURER SAVES FROM 20% TO 30% IN COAL COSTS
by installing Riley-Jones Stokers

"We get from 20 to 30% saving over the hand method. We also notice a smaller amount of ashes."

The Brewer Titchener Corp., Cortland, N. Y.

BY INSTALLING RILEY-JONES STOKERS

The Jones Stoker is the daddy of all underfeed stokers. The first Jones Stoker was built in 1888. Continually since that time improvement after improvement has been applied so that today its outstanding features make the Jones preeminent in the small stoker field. When side dumping stokers are required it will pay you to investigate the Riley-Jones Stoker.

COMPLETE STEAM GENERATING UNITS

BOILERS - SUPERHEATERS - AIR HEATERS - ECONOMIZERS
WATER-COOLED FURNACES - PULVERIZERS - BURNERS
MECHANICAL STOKERS - STEEL CLAD INSULATED SETTINGS

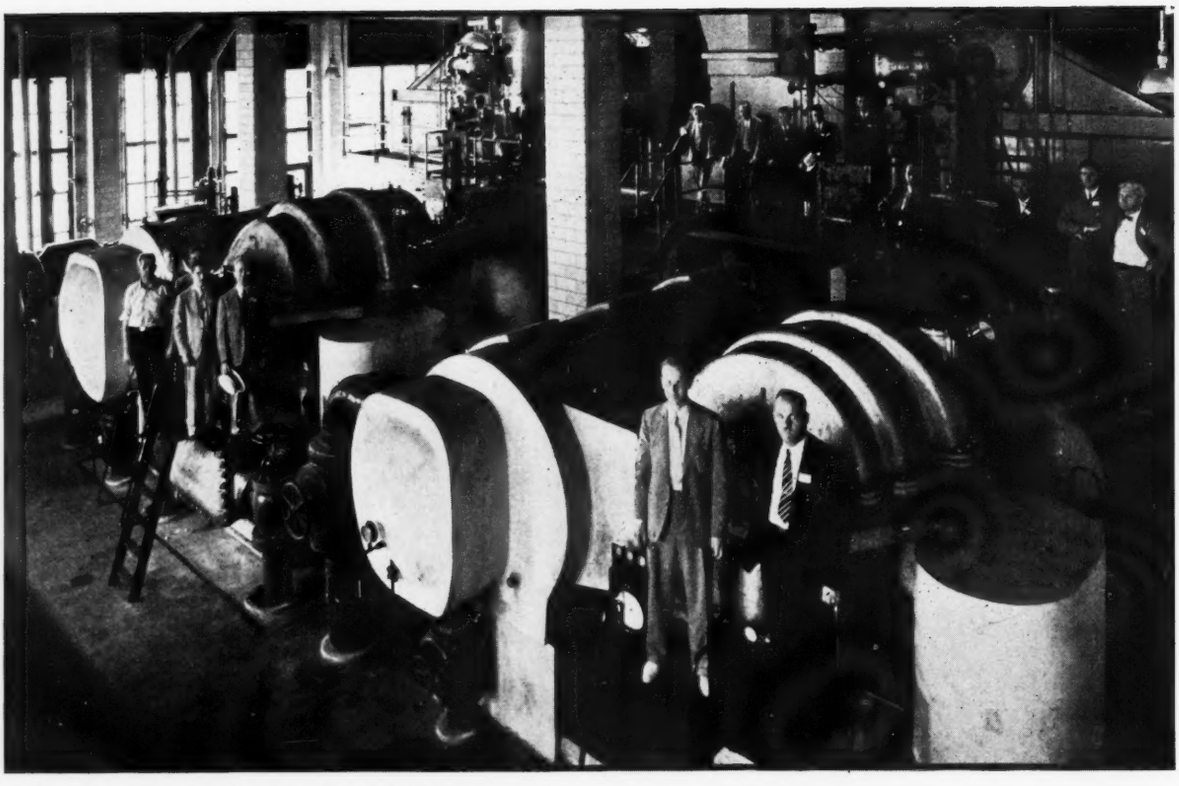


Fig. 6—Schaeffer Brewery, Brooklyn, N. Y., installed "Carrene" centrifugal refrigeration to condense ammonia in ammonia system

world. The $6,500,000 fish ladder in the dam is a center of interest to engineers, conservationists and others. Then again, how the power will be disposed of, and to whom, is still a source of much speculation.

The two 55,000-hp Kaplan turbines being installed in Pickwick Landing plant on the Tennessee River, to operate under a 60-30-ft head, rank in capacity next to the Bonneville units and are scheduled for operation in 1939. This plant is planned for 6 units, a total capacity of 330,000 hp.

Grand Coulee

The Federal Government is working on several other projects for which power equipment has not been ordered. Notable among these is Grand Coulee on the Columbia River. Funds have been made available to continue construction of the dam, which according to present indications will be 4,100 ft long and built to a final height of 550 ft. Two power houses, one on each side of the river, with nine 140,000-hp units, are part of the final project. A market for power from this plant is still an unsolved problem, but the irrigation project which is part of the development will require 660,000 hp for operating pumps.

Work has been started on the Central Valley project in California by the Bureau of Reclamation at an estimated cost of $170,000,000. This project includes a power installation of 300,000 hp at Kennett dam on the Sacramento River.

Now that the Federal Government is definitely in the waterpower business, the chief problem seems to be to find a market for the power. Improvements in steam plant have made it possible for steam to supply power more cheaply than it can be supplied by government hydro plants.

Just what form future waterpower developments will take is anybody's guess, but apparently the Federal Government, under the guise of flood control and navigation, will assume an ever-increasing influence. These factors are already becoming a dominant issue on rivers that formerly were considered non-navigable streams.

DIESEL MOVES AHEAD

The diesel field continued its rapid development, and with increasing emphasis on small units, as in 1936. There is a growing market for the diesel unit—a small engine, generator, radiator, oil cooler, air filter and fuel tank and starting method assembled on a single bedplate. Several additional manufacturers are planning such units. In spite of predictions of several years ago that the large diesel (1000 hp and up) was doomed, inquiries are active in the range of 1500 to 3500 hp.

Smaller Engines, Higher Speed

The trend is to use more units per plant and a lower percentage of standby capacity. The modern diesel operates better, its operators understand more about operating it and maintaining it, and general confidence in the diesel has increased.

Many multi-engine plants have units of several different sizes to handle all loads at high efficiency. Such engines usually vary in number of cylinders only, so that the same repair parts fit all.

The modern diesel is an increasingly smaller, higher-speed machine, depending upon newly developed materials to give greater strength with less weight. It is more sensitive to fuel variations, yet costs less and has lower maintenance than its older and heavier predecessor. In many respects modern diesels are a development of automotive design.

In addition to the generating set with a diesel, units are also available in which the engine drives an air compressor, a refrigerating compressor, a hoist, or similar machine. Thus some manufacturers now build diesels on a production basis, selling "stripped" engines which the purchaser applies to his product for resale. The trend in the next several years may be toward the mass production of such stripped engines in smaller sizes. Large engines will

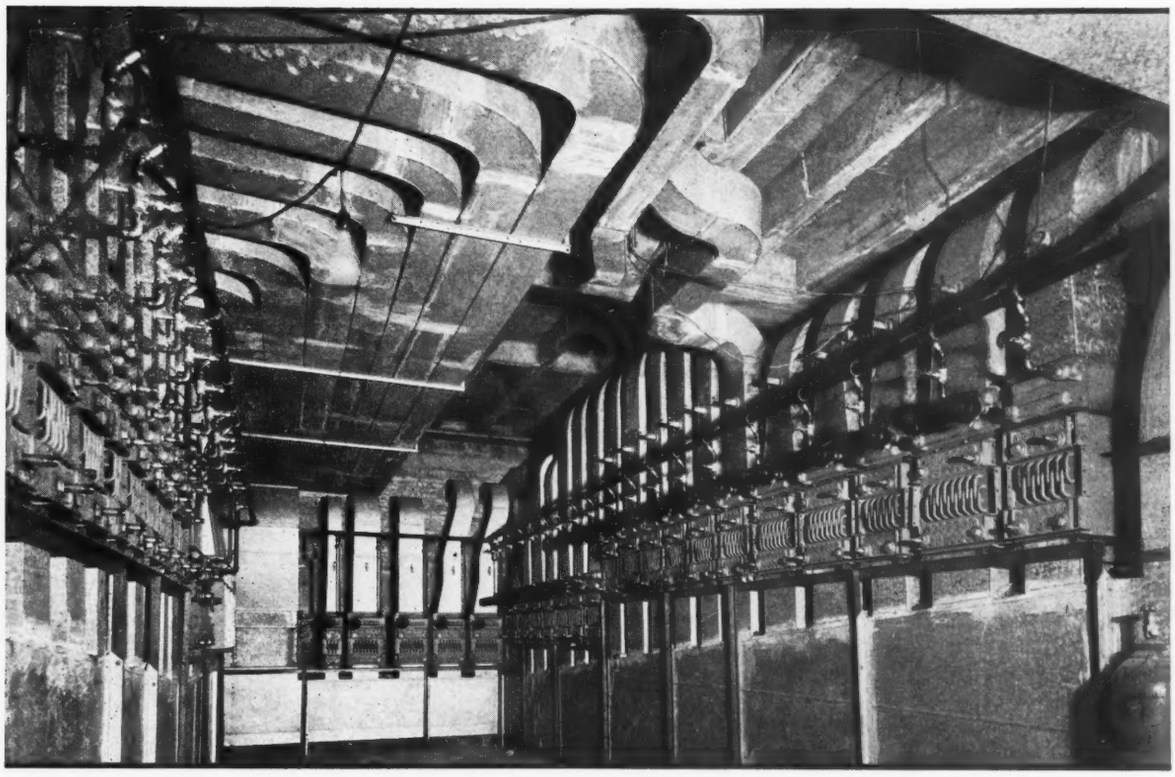


Fig. 7—Complete air conditioning of 63 individual spaces in National Aluminate's windowless building required this mass of ductwork

continue to be custom-built for some time, although many makers now have standardized on two or three cylinder sizes, obtaining power variations by changing number of cylinders and speed (where possible). These trends are healthful and necessary; only in this way can diesel prices be reduced.

One manufacturer announced this year the development of a large diesel capable of burning natural gas (on the diesel cycle). Efficiency runs somewhere in between that of the conventional gas engine and that of the oil-burning diesel, but where natural gas is cheap, this engine has real possibilities.

Gas Engines

The gas-engine field has also been very active, many new installations being made wherever natural gas is available. The newer gas engines are multi-cylinder verticals, looking much like the conventional automotive gasoline engine. They are combined into sets as are the diesels, particularly with refrigerating compressors for air conditioning in the Southwest and with pumps for the oil fields.

Sludge-gas engines also find increasing use, providing power for sewage-disposal plants directly from the gas generated. Here again waste is being utilized, automatic control is being applied and the importance of clean gas is being recognized.

ELECTRICAL DEVELOPMENT

The interest manifested last year in 3600-rpm hydrogen-cooled generators continued in this year's commitments. The two 60,000-kw, 3,600-rpm machines for Windsor plant at Beechbottom, W. Va., and the 75,000-kw, 1,800-rpm machines for Cahokia station, St. Louis, Mo., are still the largest hydrogen-cooled generators reported on order. A 50,000-kw unit, designed for hydrogen cooling, started operation in 1937.

Waterwheel Generators

Among the largest waterwheel generators ordered were two more for Boulder-Dam and two for the Pickwick-Landing plant on the Tennessee River. The former are rated at 82,500 kva, 16,500 volts, 60 cycles and the latter 40,000 kva, 13,800 volts, 60 cycles, 81.8 rpm. Housing diameter is 44 ft. Rotor and shaft weigh 570,000 lb. Thrust bearing is designed for 2,000,000-lb load.

Mercury-Arc Rectifiers

Steel-tank mercury-arc rectifiers applications were broadened by further development of electrically energized grids, which permit voltage control over a wide range, as well as control of current or power output. The grids give additional protection of rectifier substation and permit more flexible control of voltage. One installation using this new control supplies dc power to a steel mill. Thirty 2,750-kw, 4,400-amp mercury-arc rectifiers are being installed by the Aluminum Company of America at Alcoa, Tenn. Another new development is a grid-controlled rectifier with auxiliaries, including vacuum pumps, panels for starting and for voltage control, make up into a factory assembled unit in ratings of 150 to 200 kw at 250 to 275 volts.

The first multiple-section ignition rectifier and the first large-capacity ignitron equipment will soon go into service in an electro-chemical plant. Because of its low arc drop, the ignitron rectifier is being economically applied in this case to deliver power at 235 to 280 volts dc. It will deliver 4,800 amp direct current.

HEATING, COOLING, AIR CONDITIONING

During 1937 more operators adopted the "degree-day" system of evaluating steam and coal used for heating. This permits a fair comparison of steam or fuel used by the same institution in different seasons or by different establishments in different localities and for different seasons. During the year Prof. Sayles of Cornell announced the results of a study of 40 hotels. He found that the average consumption

of heating steam was 0.97 lb per deg day per 1,000 cu ft. Similar degree-day constants are greatly needed for other types of buildings and institutions.

Refrigeration

A much talked of advance in the art of refrigeration has been the combination of an ammonia system with another refrigerant circuit to eliminate the ammonia compressor. Recent installations at Narragansett Brewery and Schaeffer Brewery use secondary "Carrene" refrigeration in which liquid Carrene, pumped to a chamber under pressure, evaporates and condenses the ammonia. Both installations mentioned use turbine-driven centrifugal compressors.

American Brewing Company, Rochester, N. Y., installed a turbine-driven reciprocating ammonia compressor. A 4-stage, variable-speed impulse turbine drives a 14x16, 125-ton ammonia compressor through double reduction gears, reducing speed from 4,500 to 185 rpm. Turbine exhausts condensing, because other steam-driven machines in plant supply enough steam to meet process and heating demands.

Air Conditioning

Air conditioning drove ahead on many fronts, particularly in service institutions where competition rules, as in department stores, hotels, theaters, restaurants, etc. Noteworthy examples include Gimbel's in Philadelphia, Joseph Horne Department store in Pittsburgh and the enlargement of the Hudson Store in Detroit to 5,000 tons of refrigeration.

First-class hotels have begun to extend air conditioning from public rooms to individual guest rooms. Practically all new hospitals and many old have air-conditioned their operating rooms. Magma Copper mine in Superior, Ariz., used air conditioning to overcome excessive heat and humidity in deep workings.

Hints of a water supply and sewage crisis was brought into the open by a published study of the Department of Commerce. More than 38 American cities over 100,000 population have passed, or are about to pass, ordinances restricting the use of water for air conditioning. Many cities are already near the limit of their pumping or sewer capacity. Evidently the water-wasting variety of air conditioning is on the way out. Expect a rapid increase in cooling towers and evaporative condensers.

PUMPS

Pumping equipment has been improved, but along well-established lines. Demand for units of very large capacity has placed a premium on efficiency and made pump design comparable with that of waterwheels. The pumps used on the aqueduct of the Metropolitan Water District of Southern California are examples. The five pumping stations will each have nine pumps rated at 90,000 gpm each. They will operate against heads of from 147 to 440 ft, total lift being 1,616 ft for the five plants. Driving motors range from 4,300 hp for the low-head units to 12,500 hp for the high-head plant. With a motor installation totaling 400,000 hp, 300,000 kw will be required.

A 1% increase in pumping efficiency on this system is worth about $50,000. The Water District, in cooperation with California Institute of Technology, built a hydraulic laboratory where exhaustive tests could be made on pumps having capacities up to 5,000 gpm and heads up to 600 ft. Models of the pumps selected all gave an efficiency of over 91.5% and it is expected that the full-size units will do considerably better. Previous to this work, efficiencies of 85 or 86% have been considered good.

Pumps for the Metropolitan Water District are dwarfed by those proposed for the Grand Coulee irrigation district. Each of 12 pumps will have a capacity of 7,200,000 gpm and will be driven by a 62,500-hp motor.

WELDING AND PIPING

Welding technique has been forced to contend with higher temperatures and pressures and with thicker and thicker walls for pressure vessels and piping. The challenge has been met; the limits have not yet been reached.

A recent trend has been to cut down pipe and vessel wall thickness by using alloy steel. Carbon-moly, for example, permits 40% reduction. An era of light-weight, high-strength alloys is here and welding is the accepted method of fabrication.

Among the developments in welding machines was the dual continuous control, permitting adjustment of arc heat and arc penetration to suit the particular application. Many new rods were developed for welding special alloy steels, as well as bronze, brass and copper.

In the field of engineering prize contests, the $200,000 award program conducted by the James F Lincoln Arc Welding Foundation was the unique event of the year. Its 446 individual awards for studies of arc welding applied to design of products and structures range from $100 to $10,000 and total $200,000. The program will close June 1, 1938.

Piping

Practically all present-day high-temperature piping is carbon-molybdenum steel, with as many joints as possible welded. Some central stations have welded headers, blow-off valves welded in place, etc. Special shapes and bends, etc, are prefabricated in the piping contractor's shop, thus permitting maximum weld quality and stress-relieving, only essential joints being welded in the field. In the intermediate-pressure and temperature field, the full range of jointing methods is used.

Many special alloys are being specified for piping for special or process service, also many special linings or finishes on standard materials. Stainless-steel tubing is being joined with compression and soldered fittings.

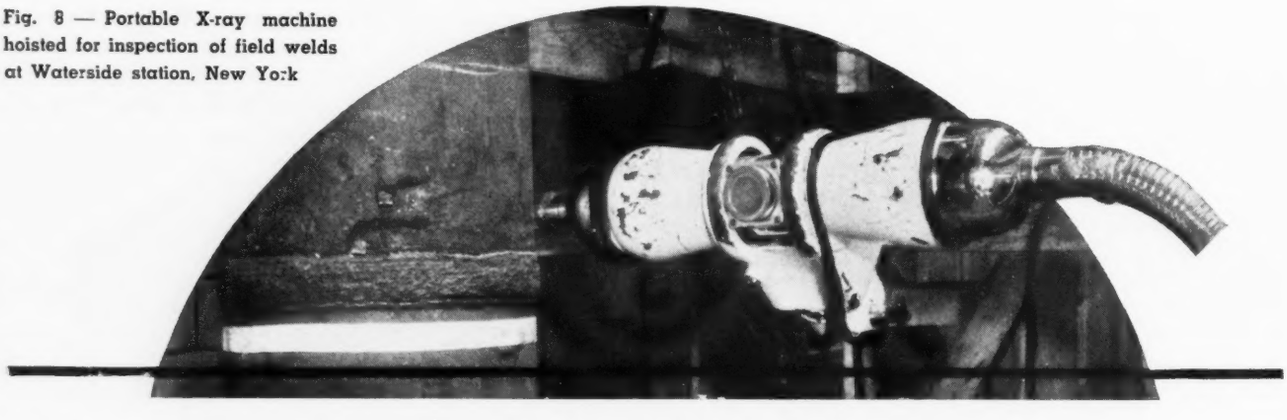


Fig. 8 — Portable X-ray machine hoisted for inspection of field welds at Waterside station, New York

The Lowdown on **Starting Up**

Operators of recently installed plants put their experiences on the table at the ASME Annual Meeting, held in New York, N. Y., Dec. 6-10

IN A frank and open discussion of the problems of starting new units, ten central-station engineers presented first-hand accounts of preliminary operating experience. Representative of up-to-the-minute steam practice, lessons in these plants guide others.

Opening the meeting with the timely subject of X-ray inspection of welded steam pipe joints, J N Landis, Consolidated Edison (N.Y.), reported on the recently completed installation at Waterside Station. Of the 138 joints X-rayed, 26 were rewelded.

The next speaker, J F Muir of Sanderson & Porter, described briefly the Springdale and Rivesville topping units. At Springdale, feedwater is being supplied the boilers at 230 F instead of the 425 F designed. The increase in input required, about 20%, has necessitated operation of the superheat damper in a nearly closed position. Were the crossover heater used, he explained, plant operating conditions were such that the steam supplied would actually come from the low-pressure boilers, while needed heat could just as well be supplied from new boilers at better efficiency.

Fisk Station

The first boiler at Fisk operated Sept 5, the second boiler and the turbine, Nov 6 and the plant has been in intermittently regular operation since Nov 16, reported A E Grunert of the Commonwealth Edison Co. Trouble with slagging of tubes and with slag tapping were experienced. One tube blew out. A few leaks at drum and economizer connections were remedied by welding. The turbine has been brought up five times.

In spite of repeated manual operation beforehand, the quick opening reducing valve stuck, Mr Grunert added, on the one occasion of a test of the system by tripping out the high-pressure turbine. After being struck with a length of bar iron the valve opened. Now the opening of this valve will be assured by oil pressure. Carryover has caused several other valves to stick resulting in changes to the steam scrubber.

One of the boilers at West End Station has been operating over seven months, stated D S Brown, Cincinnati Gas and Electric Co. Slag collection on the vertical water screens increased superheat temperature 60 F. Partial stud tubes in these screens have been replaced with smooth block.

On two occasions a boiler-feed pump has rubbed, he added, due to complete closing of the feedwater regulator when the pump bypass was closed. Now the bypass is left open. Trouble with the desuperheater was experienced when the water supply temperature fell below 300 F. This was remedied by reconnecting the piping so the cold water went directly to the nozzle, the tank then acting as a surge receiver only. The turbine operated only a few hours when the condition of the first stage impulse blades warranted sending the rotor back to the shop for reblading the first two rows.

Millers Ford

Tube leaks at rolled joints due to torsional stress were cured at Millers Ford Station by seal welding, stated C H Spiehler of the Dayton Power & Light Co. Steam formation in the economizer, however, caused badly swinging drum water levels and erratic operation of the feedwater regulating valve. A reconnection of the economizer sections is expected to improve the condition.

An hydraulic coupling failed. Precipitator efficiency is low, about 65%. Boiler-feed pump shaft packings have given trouble and erosion of the pump castings has required welding.

The turbine first operated on Sept 1. After a period of operation with the generator cooled by air, hydrogen was introduced Oct 12. The unit has turned out eight million kwhr to date and has been in service about 50% of the elapsed hours since starting

Expressing satisfaction with the per-

THEY SAID

W E CALDWELL. New York — Starting boilers with city gas and an adequate precipitator installation has resulted in a clear stack at all times.

D S BROWN. Cincinnati — Experience with the first of three boilers has led to changes in the remaining two, resulting in improved slag conditions. Smooth blocks were substituted for stud tubes in certain sections.

A E GRUNERT. Chicago—Fisk Station is just beginning to emerge from the preliminary operation stage. The reducing valve stuck on operating test but the trouble has been corrected by installing oil-pressure opening gear.

J A REICH. Richmond — Availability of the new unit 99.9% of the time when it was needed during the past 13 months has returned 13% on the investment.

J N LANDIS. N. Y.—X-ray inspection shows conditions in a few joints that the most liberal engineer would want removed from high-pressure piping. We X-rayed all field joints on the Waterside piping just completed and plan to X-ray the next job.

formance of the large boiler unit at Logan, W. Va., Philip Sporn, American Gas & Electric Co, said that loads as low as 200,000 lb per hr had been carried without difficulty. A change in baffles had been necessary to correct a tendency in the boiler circulation for dissolved solids to concentrate in one side of the twin-set boiler. The pressure-reducing station, he added, had been found a great advantage during the period of initial operation and in starting. Leak-off on boiler feed pumps, however, was twice that expected. The generator performance was reported as satisfactory with hydrogen at one-half lb pressure. Leakage of hydrogen amounts to about $6 per week.

The Omaha, Neb., boiler has operated 84% of the elapsed time since starting in Feb., reported Louis Elliott, Ebasco Services. Costs outran original expectations due in part to deep-pile foundations required. The boiler unit, he said, tested 85.6% efficiency and the station performance of 12,800 Btu per kwhr agreed closely with expectations. The turbine has operated 66% of elapsed time at an average combined load of 22,000 kw.

J A Keeth, Kansas City Power & Light Co, said that delays in receipt of material had held up initial operation of the new boiler at Northeast Station until Nov 9, since which time the unit had been in intermittent operation. To get the inside boiler surfaces clean initially, he remarked, required three separate boiling out operations using trisodium phosphate. Resetting of safety valves was required, the initial blowdown range being about 100 lb.

Reporting 13 months operation at Richmond, Va., J A Reich remarked that the original plan of lighting off with propane gas had to be discarded in favor of an oil-burning system. Their practice is to bring boiler and turbine on the line in about two hours. Infiltration of air through the boiler casing caused low superheat conditions, and was only detected by a first pass CO_2 reading with a water-cooled Orsat.

Starting boilers with city gas has been satisfactory at Waterside, said W E Caldwell, Consolidated Edison, N.Y. Stack is clear in starting and in operation. Oil leakage in the generator hydrogen seals required cleaning the windings and the generator is now operating at slightly reduced capacity with air cooling. The first row of turbine blades was damaged by a foreign object and the turbine is operating without impulse blades with load controlled by steam pressure.

A bellows type expansion joint in the low-pressure line leaked and has been replaced by solid pipe.

High-Temperature

Joints

Ring reinforcement of full-size branch connection developed full strength of pipe on hydrostatic test. Other papers discussed stress in bolted joints

Arthur McCutchan tested a welded manifold

E O Waters studied creep in flanges

E L Robinson analyzed temperature variation and creep

PRESENTING the results of an investigation of stress conditions in an 8-in. diameter manifold having a full-size welded branch connection, F L Everett, University of Michigan and Arthur McCutchan, Detroit Edison, compared a reinforced with an unreinforced joint. High stresses were found to exist on the outer surface at the flat portion on the side of the manifold.

The ring-type reinforcement used, similar to that recommended by the Boiler Code for reinforced nozzle openings, was found to assume its share of the load in the region covered but increased somewhat the stresses in the material of adjoining areas. Eventual failure of the manifold under hydrostatic pressure occurred outside the reinforced region at a pressure about the same as would be expected to burst a straight length of pipe.

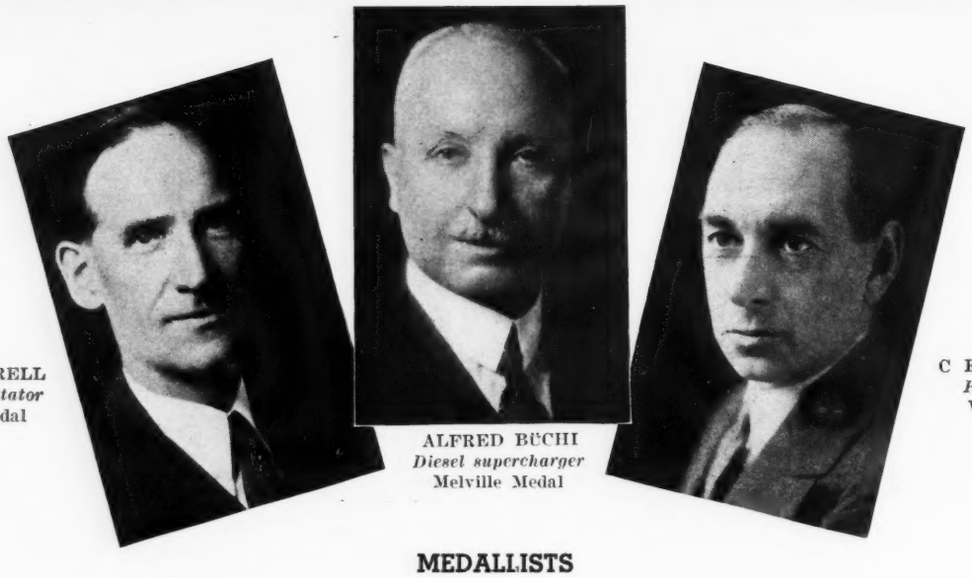
Several different types of reinforcement have been used, depending on the ingenuity and prejudice of individual designers. It is reassuring to hear reported that the joint tested developed the full strength of the pipe, failing outside the weld at a pressure of 8750 lb per sq in. A comprehensive series of bursting tests on full-size welded manifolds with and without various types of reinforcement is being planned.

E R Seabloom, Chicago, presented additional data on the manifold tested by the authors, from the work done in the Crane Co laboratories. He also showed pictures of the type of failure of each of three different manifold end-blanks, as well as several other welded joints tested to destruction. Dr Jacobus complimented the authors and expressed his gratification that empirical boiler-code formulas intended only for small connections to large drums could be applied to pipe with safety.

Papers by Professors Marin of Rutgers and Waters of Yale gave analysis of stress conditions in bolted joints at high temperature. Under creep conditions, according to Professor Waters, relaxation flow would theoretically permit use of smaller sections, but tightness of joints depends on the elastic stretch of bolts and flanges. The length of time a joint will stay tight under creep conditions is then as important a part of the flange design as stress condition.

Horizontal joints in turbine casings cannot be eliminated and cannot depend on gaskets for tightness, began C B Campbell, Westinghouse. They also must remain tight under temperature gradient along the joint and when subjected to extreme and rapid temperature changes.

E L Robinson talked of creep studies of the General Electric Co and the use of the data in determining creep rates for materials hot only part of the time. Also for the case when one end is hot and the other end cold. It is easier to predict, he said, the behavior of a given bar under varied temperature conditions than to fix the behavior of another supposedly identical bar under the conditions tested. Mr Kanter, Crane Co, showed curves relating creep rate to energy changes within materials.



F G COTTRELL
Dust precipitator
Holley Medal

ALFRED BÜCHI
Diesel supercharger
Melville Medal

C F HIRSCHFELD
Power research
Warner Medal

MEDALLISTS

Chlorination Pays

After 10 years, chlorination of condenser circulating water is here to stay. Several variations of method are in vogue

REVIEWING the history of slime control by "Chlorination of Condenser Cooling Water," R B Martin of Wallace & Tiernan Co summarized the development of limestone tower and program-control treatment from the work at Kearny, N. J., in 1928 up to the present time. Limestone towers and their associated equipment, Mr Martin said, were soon found to be limited in flexibility and responsible for relatively high maintenance charges. In recent installations, the program-controlled, large-capacity chlorinator has been favored, equipped with a rate-control device to adjust the treatment to suit various individual condenser circuits.

Speaking of variations of the treatment process, Mr Martin stated that equipment developments have been going forward to take advantage of recent variations in frequency and duration of chlorination schedules directed toward more efficient and more economical use of chlorine. In one case, the circulating water flow is reduced during the period of chlorination and in another the condenser is taken out of service and chlorinated water allowed to remain in the condenser for a period of reaction. The suitability of these variations of intermittent treatment, he added, depends on individual-plant operating conditions, it seldom being found convenient to shut down individual condensers either partially or completely.

The author stressed the importance of routine chlorine residual tests and biological laboratory findings in scheduling chlorine application. The presence of ammonia either naturally in the water supply or added intentionally results in the formation of chloramines under certain circumstances, generally slowing the sterilizing action of chlorine. In two cases advantage has been reported from the formation of chloramines.

Opening the discussion, V M Frost of Public Service of New Jersey reminded the audience that some of the original fundamental work in chlorinating had been done in Chicago under the direction of the chairman, Mr Grunert. M A Stone, consulting engineer, asked if the chlorine treatment were as effective in sea water as in fresh water, to which the author replied that many installations in both types of water had been successful.

M H Curley reported the use of chlorine in a Long Island, N. Y., installation for eliminating mussel growth. The secret, he said, is to treat regularly, catching the infant mussel when it is so small it will pass through a felt hat. Chlorine destroys the marine growth upon which the mussel must make a home.

Discussion of the formation of chloramines by the addition of ammonia salts was opened by M S Maurer, Brooklyn-Manhattan Transit Co, N. Y., who asked if the author had had experience with chloramines forming from ammonia naturally present in the water, stating that he had found addition of ammonia salts necessary in two or three cases along the Atlantic seaboard. Mr Martin replied that in a Middlewestern installation where industrial wastes were present with ammonia but not high organic content, chloramines would form.

Miss I B Romans, bacteriologist, stated that entirely different results were obtained when pure water was used in finding chlorine residuals from those found when a fresh sample of contaminated water from the normal plant supply was employed. The author closed discussion with the statement that the same results could be obtained in determining residual if a corresponding amount of ammonia were added to the pure sample.

3-Dimensional Pipe Bends

Supplementing his previous paper of 1935 on "Stresses in Three-Dimensional Pipe Bends" Prof William Hovgaard discussed the secondary terms which occur in the stress calculations. He represented revised rigorous formulas in which all the secondary terms had been included and felt that secondary terms could be omitted from practically all usual computations. Discussing the paper, Arthur McCutchan, of Detroit Edison, qualified the author's general statement with the assertion that field tests generally showed appreciable and consistent variation from the calculated values. For this reason, he said, a rigorous solution is required only in exceptional cases having short tangents. He added that the designer can only state with surety that reactions will not exceed calculated values.

Metals Battle
Hot Water and Steam

Tests show that 18-8 alloys have highest resistance to oxidation by superheated steam

NOW THAT commercial temperatures approach 1000 F, the oxidization of steam piping by superheated steam is a practical matter. At Purdue University, Dean A A Potter, Prof H L Solberg and Prof G A Hawkins are searching out the facts. Prof Solberg revealed their findings in a session devoted to power-field chemical problems.

The Purdue experimenters tested the oxidizing effect of high-temperature steam on steels of varied composition. Pressures ranged up to 1600 lb, temperatures normally to 1100 F, with a few short runs at 1200 F, and plans for 1300 F. The amount of oxide produced was measured directly, after trouble with indirect determinations by hydrogen measurement.

Velocity and Pressure

Steam velocity and steam pressure had little effect, nor did any of the steels oxidize seriously at temperatures below 1000 F. Beyond that point, oxidation increased rapidly with temperature. Of the many steels tested, best results were obtained with 18-8 alloys, worst with low-carbon steel.

In a supplementary presentation, Dean Potter concluded that the ideal steel to resist high temperature steam should form a thin, dense oxide scale, one not likely to crack off and expose the metal to further attack. New equipment planned for the Purdue Laboratory will permit simultaneous testing of 35 different materials, he said.

In the discussion, C H Fellows told of the work done by Detroit Edison, starting in 1928. Detroit is cooperating with Purdue on the present experiments, and is working independently with "cages" of steel bars inserted in high-temperature steam lines. After 3840 hours exposure at 1100 F, 18-8 alloy was least affected, low-carbon the most, with other compositions covering the intermediate range.

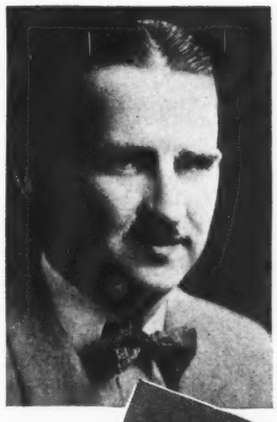
For years the battle of the chemists has raged around the "intercrystalline cracking" of steel in water solutions—what was once called "caustic embrittlement." Engineers cheer on the side lines because a real understanding of this trouble will save boiler operators a lot of grief. This year's contribution came from W C Schroeder, A A Berk and R A O'Brien, all of the U S Bureau of Mines. Their work was carried out with the cooperation of the Joint Research Committee on Boiler Feedwater Studies.

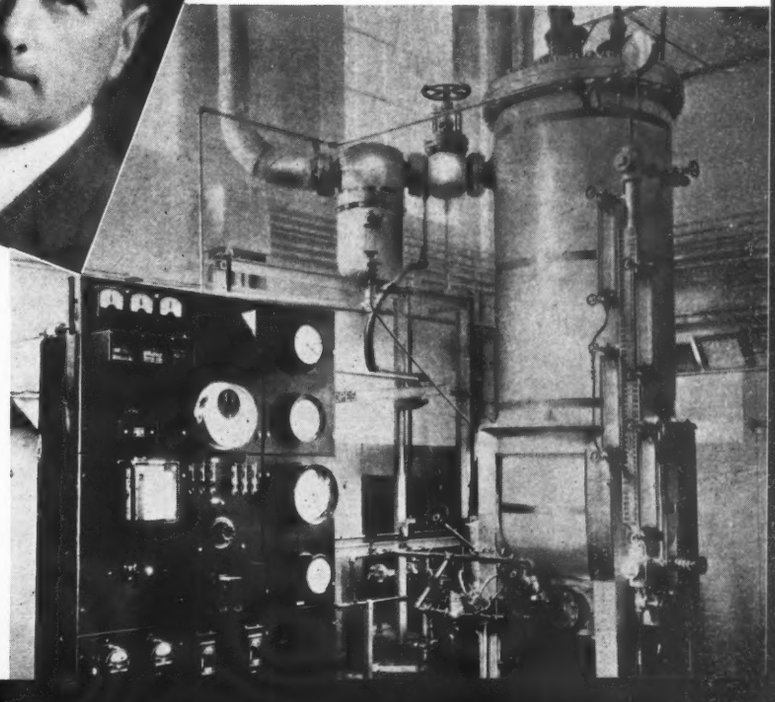
Most interesting was their laboratory finding that lignin sulphonate, concentrated sulphite waste liquors, Philippine cutch and quebracho prevented cracking even when a very high stress was applied at elevated temperature. This protection was not destroyed by high concentrations of sodium silicate or sodium hydroxide. The sulphite liquor was found suitable at all temperatures up to 250 C. Definite temperature ranges had to be observed with all the other compounds tried.

It was also found that a high concentration of sodium sulphate will prevent failure of boiler steel in tension in sodium hydroxide-sodium silicate solutions if two conditions are satisfied: (1) stress in metal must be practically constant while it is in contact with the solution at elevated temperature; (2) the sodium-hydroxide concentration must not greatly exceed 25 g per 100 g.

Sodium Sulphite

W O Taff and Profs H F Johnstone and F G Straub, University of Illinois, reviewed their experiments on the decomposition of sodium sulphite solutions at high temperatures. The sulphite is now widely used to prevent corrosion by removing the last traces of dissolved oxygen. 4-hour tests, made in steel bombs, indicated that decomposition to sodium sulphide, sulphate and thiosulphate begins to take place at some temperature between 530 and 560 F.





Prof F G Straub (above) of Illinois studied effect of temperatures on sulphite solutions, while Dean A A Potter (left) of Purdue searched for steels to withstand oxidizing effect of high-pressure, high-temperature steam with the experimental super-pressure boiler at Purdue (below)

—Courtesy U S Bureau of Mines

Attack on **Coal-Burning Problems**

Successful firing of low-grade coals claimed for water-cooled stoker; slagging troubles persist

EFFICIENT and reliable operation with low-grade coals is the operating record of the water-cooled stoker, according to J S Bennett of the American Engineering Co. Since this stoker was introduced in 1934, valuable experience has been gained, leading to improvements in design and better knowledge of operating characteristics. In the first installation, molten ash had a tendency to run under the bottom pushers causing them to bind. Self-cleaning pushers and increased cooling to chill the ash more effectively overcame the trouble. It was found desirable also to increase the overfeed section of crusher-type stokers, in order to reduce combustible in the ash and to make a more friable ash. Crusher rolls were equipped with extra teeth at points where the ash flow tended to be sluggish. These changes, and a new type tuyere, have been incorporated in most of the newer installations.

Experience has shown no serious abrasion of the tubes from the movement of the fuel bed. Tubes have been cut out and carefully measured, and on the basis of these checks, it is estimated that the heavy-gage tubes now used have a probable service life of 33 years.

The first water-cooled stokers employed forced-circulation because it was incorporated in waterwalls already installed. Other units have been designed for natural circulation, introducing new problems in the design of both stoker and waterwalls. Arrangement of the cooling system must be such that it can be combined with a wide variety of boilers and furnaces, and first cost, accessibility, ease of cleaning, and appearance must also be considered. These new conditions were met by laboratory research and field test. Extensive investigation of tube temperatures has shown that the metal temperature does not materially exceed that of the saturated steam.

Various arrangements of stoker cooling surface and circulating tubes have been devised. In one installation, the front of the ashpit and the stoker are cooled by tubes that run continuously from a header at the base of the ashpit through the stoker to a header in the front wall, thence under the front arch and over the combustion space to the rear or return header of the cross-drum straight-tube boiler. These return tubes are, in effect, the lowest row of tubes of the boiler surface and are staggered to form a slag screen. In another plant the tuyere tubes provide protection for the lower portion of the front wall, while the upper portion is cooled by a separate wall. Water passing through the stoker retort tubes to the header in the windbox supplies a number of tubes in each sidewall. In a continuous-discharge stoker installed under a bent-tube boiler, tubes from both the tuyeres and the retorts run up the front wall and enter a header at the top of the wall. The simplest circulating system, is one in which the tuyere tubes and the risers from the retort-tube header in the windbox are carried directly up the furnace front wall to the drum.

Oil or natural gas can be burned successfully in furnaces fired by water-cooled stokers. One such installation has gas burners in the rear. By maintaining a light fire at all times, and by reducing or increasing the coal burning rate as the quantity of gas used is varied, it is possible to change from gas to coal on extremely short notice, without loss of steam pressure. The slow coal feed prevents spontaneous combustion in the bunkers when the gas is burned and the incandescent coal bed is available at all times to pick up the load. Where gas is employed at frequent intervals the burners are cooled by bleeding a small quantity of air through them, and when coal only is used for long periods, refractory screens are employed.

That radiation from the heated ash particles is a factor of major importance in pulverized fuel furnaces was demonstrated by W J Wohlenberg and D E Wise of Yale University, who presented a comprehensive mathematical analysis of the energy distribution in a pulverized furnace cavity. Equations for furnace energy, equilibrium at the burning particle, equilibrium at the ash particle, and equilibrium at the refractory surface, were set up, combined, and reduced. The result is an energy distribution diagram, indicating that for the case studied, direct radiation from gas to wall accounts for about 8% of the released energy, radiation from the ash to wall about 13% and from heated gas to wall about 14%. Radiation from the ash particles can be shown to be largely responsible for maintaining the emissivity of the flame well down into the furnace, after the carbon has burned out. Application of this method of analysis makes possible the determination of the energy absorption at various parts of the surfaces around the furnace.

Slag and Deslagging

Slagging is an old problem, especially to operators burning midwestern coals of low ash-fusion temperature, declared A D Bailey of the Commonwealth Edison Company, in opening a panel discussion on coal-burning problems. He pointed out that chemical treatment has been a failure to date and that all physical means have been tried with no great success. Boilers can be operated for longer periods because tubes are more widely spaced, and more accessible, making cleaning during operation possible.

Constant effort has been made to avoid slagging by various kinds of treatment before burning. Pretreatment at the mines, such as careful cleaning, is helpful, but often uneconomical because of the high cost.

Hard To Check Claims

Because of the importance of the slagging problem, operators have been extremely open-minded about trying various proposed solutions even though sellers of products designed to reduce slag or change its nature offer little or no data on which to judge its merits. Most such products consist of rock salt, as analysis has shown, but it is extremely hard to prove or disprove the claims made as to their effectiveness. Boiler operating conditions are so variable as to make any real tests extremely difficult to make in actual practice. It is common procedure to check the effectiveness by a visual inspection which is, of course, not entirely satisfactory. When evaporation tests are tried, the effect is often so small as to be within the probable error of the test, since boiler testing, even under favorable circumstances, is still not an exact science. Experience at Commonwealth Edison has developed no compound worthy of continuous use for deslagging, although it is not yet possible to report on the value of molybdenum salts, the most likely of all compounds which claim to solve slagging problems.

Several ways in which slagging troubles might be reduced were put forward in discussion by P Nicholls of the Bureau of Mines. In the case of stokers, a better fuel bed will tend to keep much of the slag in the bed, instead of its being blown into the furnace. High furnaces and slag screens lower slag temperature before it reaches the steam-generating tubes. Another line of attack is to reduce the ability of the slag droplet to stick to the tube surfce, either by changing the nature of the surface or by coating it with a film to prevent sticking. Some chemicals may be found to combine with slag, changing its character, or fluxing it, but no one chemical is likely to fit all slag conditions. In further discussion, M D Engle, Boston Electric Illuminating Co, pointed out that slag troubles may occur with coals of high ash-fusion temperature also.

Slagging troubles in plants serving a district heating system were described by J D O'Brien of the New York Steam Company, who traced the steps taken over the past 20 years to combat slagging. Of plans tried, lancing with water and rodding seem the most practical.

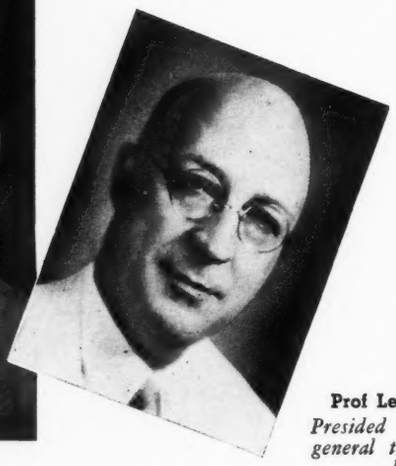
Dedusting Coal

Cleanliness is a highly desirable characteristic in coal, R A Sherman of Battelle Memorial Institute said, in reporting progress of a research program on the effectiveness of spraying with oil to reduce dust. With laboratory equipment designed to simulate actual practice, Island Creek coal and Illinois No. 6 coal were sprayed with oils of various viscosities and with petrolatum. It was found that for the Island Creek coal, oil of 200 ssu was more effective than oil of 100 ssu and in the case of the Illinois coal petrolatum was superior to oils of 600, 200 and 100 ssu, respectively. In each case, a small amount of oil reduced dust drastically, and larger quantities made less and less improvement. The Illinois coal, probably because of internal cracks which absorbed oil, required more oil than the Island Creek coal. Oil treatment lasts fairly well, dustiness increasing with time of exposure to some extent. Reasonable amounts of oil will treat effectively for six months or more.

J S Bennett gave record of water-cooled stokers

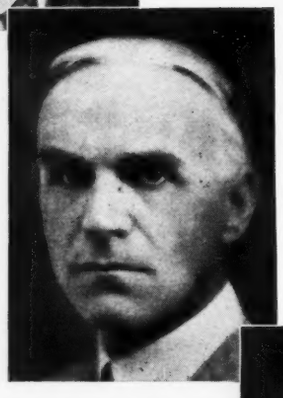
A D Bailey discussed slag and deslagging

Prof Robert W Angus
Chairman, Subcommittee on Penstock Failures



Prof Lewis F Moody
Presided at session on general theory of water hammer

S Logan Kerr
Chairman, Water Hammer Committee



Norman R Gibson
Member, Water Hammer Committee

Malcolm Pirnie
Presided at session on water hammer in waterworks systems

Water-Hammer Symposium

Sixteen papers and reports by an international group of specialists discuss water-hammer problems of water power, pumps, water conduits, and the similar problem of liquid flow in diesel fuel-injection systems

WITH THE EXCEPTION of a world-power conference or similar meeting, seldom has there been an engineering meeting as international as the second water-hammer symposium. Representatives came from ten universities, three consulting-engineering and three power-plant companies in the United States and Canada, and from France, Great Britain, Switzerland, Italy and Brazil. To bring together such a large cross-section of world engineering and scientific thinking and experience on a problem like water hammer represents an outstanding achievement in advancing hydraulic engineering, particularly the safety of water conduits.

The symposium was presented under auspices of the Committee on Water Hammer, Hydraulic Division, American Society of Mechanical Engineers, in cooperation with the Power Division, American Society of Civil Engineers; Engineering Institute of Canada; American Water Works Assn and others. Great Britain and the British Institution of Mechanical Engineers were represented by E Bruce Ball; Italy by Lorenzo Allievi; Switzerland by Dr-Ing Charles Jaeger and Dr-Ing O Schnyder; Brazil by F Knapp; Canada and the Engineering Institute of Canada by Prof Robert W. Angus, University of Toronto, and Prof F M Wood, McGill University; France by Prof Louis Bergeron, Ecole Centrale and Prof P Danel, University of Grenoble.

By action of the Committee on Water Hammer, Lorenzo Allievi has been appointed honorary chairman of the Committee, and the ASME conferred an honorary membership in recognition of his contributions to the advancement of knowledge on water hammer.

In the first session of the symposium, general theory of water hammer was considered. "Air Chambers for Discharge Pipes," by Lorenzo Allievi, presented by E B Strowger, discussed applications of the general formulas of turbulent flow to the functioning of air chambers connected into discharge pipes. The law of pressure oscillations after sudden cutoff of power to the pump

was fully investigated. By means of approximate energy balancers, simple rules were found for the selection of chamber dimensions and for the increased coefficient of friction of the descending flow.

Fuel oil is introduced into the cylinder of the solid-injection diesel engine in accurately measured "shots" in the form of a fine spray. This involves a frequent starting and stopping of the liquid flow which gives rise to transient phenomena closely akin to the water hammer occuring in hydraulic conduits, discussed by Kalman J DeJuhasz in "Hydraulic Phenomena in Fuel-Injection Systems for Diesel Engines." Knowledge of these phenomena, which greatly influence the characteristics of the injection, and thereby influence the performance of the engine, is required for rational design of the injection system. For satisfactory engine performance, the injection system must accomplish accurate metering, correct timing, and must consistently discharge at a constant rate. The system should also permit variability in timing and metering as engine load and speed vary.

It was shown by DeJuhasz that insofar as injection systems and hydraulic conduits involve a disturbance in the equilibrium of liquid flow, the injection process and the surges in hydraulic conduits are related phenomena obeying the same basic natural law. However, in hydraulic conduits, attention is focused on the forces and stresses to which the structure is subjected, but in injection problems, time rate of discharge, velocity and pressure changes, and their consistency or inconsistency between successive injections are of primary importance.

Penstock Failures

A report on penstock failures was presented at the second session by Prof Robert W Angus, after which Prof P Danel gave a very comprehensive explanation of the 1934 penstock failure at Lac Noir pumped-storage hydro plant in France.

For operating the closing mechanism of a shutoff valve in case of a pipe rupture, a change in flow conditions gives the necessary impulse. These changes of flow conditions must reach values obtained only in an emergency, but never reached in normal operation. F Knapp, in "Operation of Emergency Shutoff Valves in Pipe Lines", discussed the hydraulic characteristics and design of self-acting shutoff valves, which operate so that water hammer, even in worst emergency conditions, remains within permissible limits.

Pipe-line operating conditions are deciding factors in the choice of the tripping device. Pressure and velocity conditions in a pipeline, near the shutoff valve, are influenced in varying degrees by a break in the line and must be examined in each specific case. As a rule, a considerable increase of velocity and a corresponding pressure drop will take place. Mr Knapp said that either a change of velocity or a change of pressure may be used to operate the tripping device, and the choice depends on whether a pipe rupture would cause at the automatic valve first, an appreciable change of velocity, and then a change of pressure or vice versa.

Protection of main branches of waterworks-distribution systems or of turbine penstocks is of considerable importance inasmuch as a rupture frequently causes extensive damage to property. In the opinion of Mr Knapp, emergency closing valves, designed without consideration to water hammer, do more harm than good and may be even the cause of accidents. A correctly designed installation should fulfill these conditions:

1. Maximum surge caused by valve closing in cases of a rupture should not exceed certain limits, determined by the strength of the pipe. This maximum pressure rise should not be influenced by quick closure or even slamming of the main valve.

2. In operating the valve, a minimum amount of water should be discharged after rupture and while closing the valve.

Design Conditions

These two design conditions are seldom met in the usual installation, Mr Knapp pointed out, but they can be incorporated in emergency-valve installations with only slight modification of the usual arrangement.

Mr Knapp concluded that time and rate of closure of automatic valves installed in main branches of waterworks-distribution systems, or in turbine penstocks, can be determined in such a manner that maximum water hammer under the worst conditions does not exceed a given limit, and, also, that the total discharge after pipe rupture becomes a minimum. To accomplish this purpose, the main valve is provided with an automatic bypass valve of definite dimensions. Design of the automatic valve is determined by the emergency condition of pipe rupture just below the valve.

If the possible operating conditions of hydraulic turbines and centrifugal pumps are compared, it is apparent that pumps are subject to much wider and more involved variations than the turbines, especially during the transient states of starting, stopping or emergency operation. This great variation in performance gives rise to many questions. Unfortunately, these questions are very difficult to answer, because, although the hydraulic performance of the machine is well known as long as it is acting as a pump, comparatively little study has been made of the phenomena as an energy dissipator or as a turbine.

R T Knapp has explored these little-known regions of performance and has attempted to use the resulting information to answer some of these important questions in, "Complete Characteristics of Centrifugal Pumps and Their Use in the Prediction of Transit Behavior." This work was done in the hydraulic laboratory of the California Institute of Technology on a 4-in. high-head, high-efficiency pump.

Surge conditions in pipe-discharge lines caused by sudden failure of power supply to the pump driving unit, in both low-head and high-head plants, particularly the latter, were discussed by O Schnyder in "Comparison Between Calculated and Test Results on Water Hammer in Pumping Plants." He gave a detailed discussion of surge phenomena in pump discharge lines for the period immediately following the failure of the power supply when pump speed and discharge both decrease; the period during which reversal of flow continues until maximum discharge is reached in the reverse direction; and the period between the maximum backward flow in the pipeline and the complete stoppage of the backward flow. Surge conditions in the discharge lines of large pumping installations, as established by tests, were given and compared with calculated results, with the conclusion that the design engineer can determine such surge conditions and also calculate accurately the effect of various devices employed to limit water hammer in pumping plants.

Other Papers

Other papers presented were "Theory of Resonance in a Pressure Conduit," by Charles Jaeger; "Experiments and Calculations on the Resurge Phase of Water Hammer," by J N LeConte; "Relations of Relief-Valve and Turbine Characteristics in the Determination of Water Hammer," by Earl B Strowger; "Application of Heavisides Operational Calculus to the Solution of Problems in Water Hammer," by F M Wood; "Water Hammer in Branch Pipes," by R. W. Angus; "Graphical Study of Water Hammer in Pump Discharge Lines," by R W Angus; "Water-Hammer Tests on Transite Pipe," by L H Kessler; "Water-Hammer Problems in Pumping Plants," by R M Peabody; and "Tests on Water Hammer in Pump Discharge Lines," by E Bruce Ball.

Bearings and Their Lubrication

Four papers at two sessions cover tests, running-in characteristics, and materials

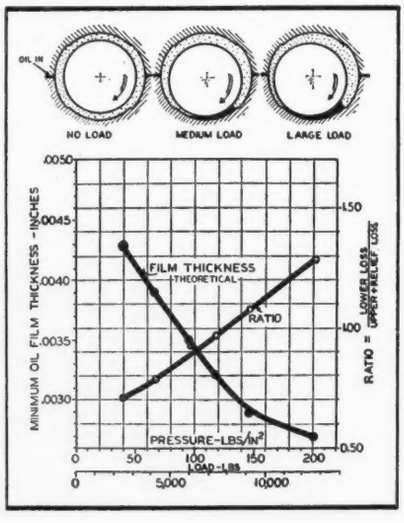
S A McKee, mechanical engineer of the Bureau of Standards, who reported further upon tests of white-metal bearings

F C Linn and R Sheppard of the Turbine Engrg, General Electric Co., dealt with film-lubricated "Thrust Bearings" used in their company's equipment. There are two fundamental types of prime movers from the thrust-bearing angle, the vertical-shaft water-wheel generator, a massive, low-to-moderate-speed element with the weight of the rotating parts plus or minus the hydraulic thrust carried by the thrust bearing; and horizontal-shaft steam turbines operating from moderate to high speeds with thrust load increasing from a small value at zero torque to high values at maximum torque. The first prime mover uses the flexibly supported thrust bearing, the second the tapered-land or marine-type thrust bearing. They reported an extensive series of tests on the tapered-land type, explained and illustrated test equipment, and charted results, all tending to show simply that the each type of bearing is now being used in its proper place.

A Bearing Test at 3600 RPM

L M Tichvinsky of the Westinghouse Research Laboratories reported on the first stage of his "Tests of a 7 by 10½-in. Bearing at 3600 RPM". He has found thus far that in bringing such a bearing to its full loading, its performance as a guide bearing at zero loading gradually changes to that of a power bearing at high loads. At small loads, losses are produced in the nearly uniform circumferential clearance, while at high loading the predominant part of the losses is produced in the carrying oil film. Relative distribution of losses in the carrying oil film, reliefs, and upper clearance can be represented graphically as a function of load and pressure on the basis of theoretical calculations. Losses and oil-film thickness at various loads and pressures are illustrated in the diagram reproduced on this page. At low and medium pressures, when losses in the load-carrying film are not very great, losses in the upper bearing half decrease due to increased clearance, as indicated in the sketches. With further loading, and consequently increased clearance in the upper bearing half, losses in the oil film of the lower half become very high. This is shown clearly in the diagram, where the effect of minimum oil-film thickness and the ratio of losses in the lower and upper halves are given as functions of load and pressure.

Heat generated due to friction is by no means confined within the clearance space, or entirely carried away by the oil. However, in the case of large bearings, most of the heat is carried away by the lubricant. While Mr Tichvinsky's equipment did not permit him to vary oil flow widely, he was able to vary it between 7 and 8.5 gpm. Within this limitation he found temperature rises varying from 8 C with an average oil-film temperature of 70 C, to 12 C with an average oil-film temperature of 52 C, these measurements being taken by installing several thermocouples along the oil lines.



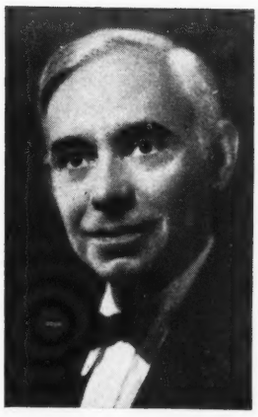
Losses and oil-film thicknesses of a 7x10½-in. journal bearing at various loads and pressures (Tichvinsky)

White-Metal Journal Bearings

S A McKee and T R McKee collaborated in investigating the "Running-In Characteristics of Some White-Metal Journal Bearings" at the National Bureau of Standards. At this meeting they were able to describe results of tests on three kinds of white-metal bearings, indicating that the effect of running-in is to reduce the friction losses as bearing pressure increases and viscosity and speed decrease, and also to increase the permissible operating range.

Metals reported on included a high-lead babbitt, a high-tin babbitt, and a hardened-tin alloy. Conclusions were: The major effect of running-in upon frictional characteristics is to increase the factor of safety at minimum-friction points. The amount of running-in required to produce a given change in the location of the point of minimum friction was greater for the leaded-bronze and hardened-lead bearings than for high-lead or high-tin babbitt bearings. In the region of thin-film lubrication, under comparable operating conditions and running-in, the bronze and hardened-lead bearings had a higher friction than the babbitt bearings. High-lead and high-tin babbitt bearings essentially alike in clearance and finish were also practically alike in running-in characteristics. Data thus far are too limited to indicate whether or not there is a general relation between mechanical properties and running-in characteristics of bearing metals.

The brothers McKee suggested further tests on the newer bearing metals and with the newer types of compounded oils.



W H McAdams investigated heat transfer to boiling liquids

New Slants on **Heat Transfer**

GENERAL thinking on heat transfer to boiling liquids has been wrong in many respects, according to George A Akin, who reported on the progress of a research program being carried out at M I T by W H McAdams, E T Sauer, H B H Cooper, and the speaker. Former investigations were confined to small temperature differences, but recent interest in high temperatures has made it necessary to extend knowledge. Tests show that the coefficient of heat transfer to a boiling liquid increases with the temperature difference at first, but reaches a maximum, after which further increases in temperature difference result in a lower coefficient. This is due to the formation of a vapor film between the tube surface and the water. Trials with many liquids and metals indicate that the coefficient of heat transfer is not lower with metals of low conductivity, as was thought.

Designers of heat-transfer equipment are constantly faced with the problem of calculating the conduction heat transfer and the resistance to flow, for a gas flowing over a tube bank. Extensive tests by O L Pierson, E C Huge, and E D Grimison, of Babcock & Wilcox Company, throws some light on the effect of tube spacing and arrangement and demonstrates, as well, the soundness of the use of scale models and the law of similarity in investigations of this kind. Using different types of apparatus, tests were run on a wide variety of tube arrangements, and a sufficient number of checks were made to indicate that the results are generally accurate. Analysis and modification of the test data was undertaken to make practical application to commercial design problems possible. With reliable information as to the effect of tube spacing and arrangement, calculations will be more accurate, and better-balanced and economical designs should result.

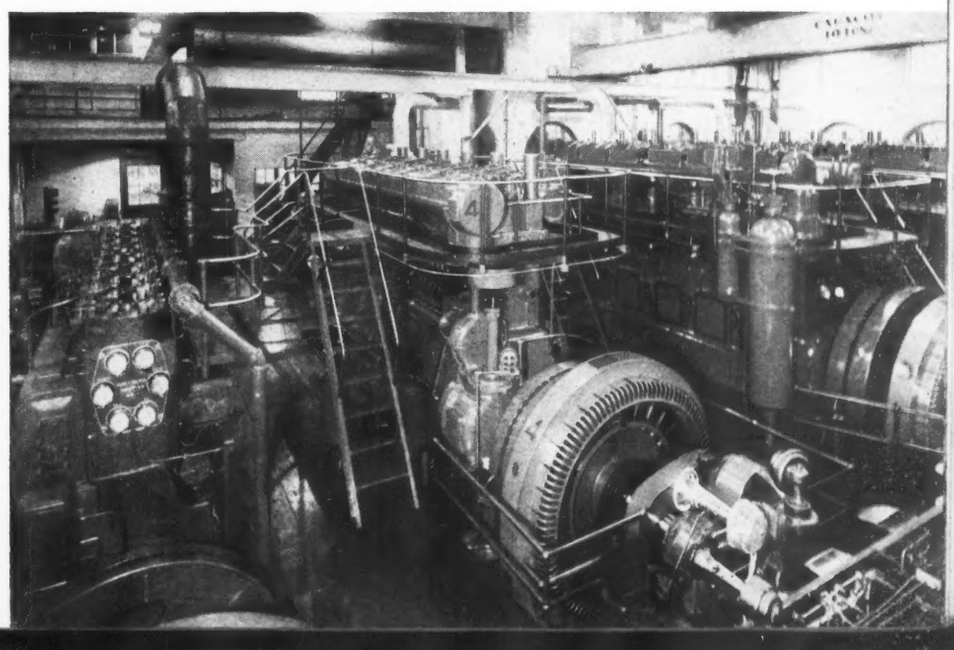
Engine Speeds and Friction Increase

F H DUTCHER, discussing "The Friction of Reciprocating Engines", showed graphically the trends in friction-speed-load relations in reciprocating engines from 1878 up to date. He attempted the impossible—a comparison of the steam engine of 60 years ago with the modern high-speed internal-combustion engine from the standpoint of mechanical friction—and got results that at least indicate a trend and suggest that modern engines have greater frictional losses than are usually suspected. I mep increases may increase, decrease, or hold constant the mean friction pressure in constant-speed engines, and speed changes likewise have no predictable effect in variable-speed engines. Prof Dutcher's tests also seem to substantiate Prof Robertson's earlier suggestion that, as pressures in a high-speed engine go up, the lag increases between pressure changes in the combustion chamber and those in the ring groove. He has succeeded in working out a test method which may, with changes, be used at higher speeds.

John W Anderson, discussing the diesel-electric switching locomotive, pointed out several interesting facts. 1930 and 1931 figures show about 2/3 in 1930 and 1/3 in 1931 of the switchers placed in service were diesel-storage-battery units. The next two years, all switchers placed in service were diesels, based on operating economy. Average rated horsepower per engine meanwhile increasd from 400 to 600. More recent engines are increasing this figure still more, because there are now some 900-hp switchers and some 1200- and 1800-hp transfer locomotives in service. Availability runs from 80 or 85 to 90%, and some railroads anticipate higher figures now that maintenance men are used to diesels. Repairs, including routine maintenance and inspection, are about 35 cents per hour of use. Total operating costs were given by Mr Anderson as: $4.14 to $4.24 per hour of use for the steam switcher, as compared with $2.45 to $2.65 per hr for a 600-hp diesel switcher and $2.64 to $2.84 for a 900-hp.

HUDSON'S DIESEL TOTAL REACHES 4255 HP

Adding 53% to plant capacity, but occupying the same space as its smaller predecessors, this 8-cyl, 14x23½-in., 277-rpm, 1480-hp, Alco-Sulzer (left) is the latest addition to the Hudson, Mass., municipal plant. It is the first installed of this new 2-cycle marine-type series and drives a 1000-kw, 2300-volt, GE generator. On test, it delivered 12.86 kw-hr per gal. at 2/3 load and 13.6 kw-hr at full load



Merry Christmas

MORE YEARS AGO than I like to think about, my belief in Santa Claus was ended abruptly by my own curiosity. I'd been sent to bed with the usual stories about Santa bringing a Christmas tree and filling my stocking, but instead I peeked through the sliding doors that separated our dining room from the very much restricted "parlor"—and saw the decorating being done by two much-more-familiar people.

That same curiosity gets me into trouble every once in a while. Recently, I got to wondering where Christmas and all its customs came from. In case you're interested, this is what I've found out: Thousands of years ago, the Persians worshipped the sun-god Mithra, "the light of the world", who lived between Heaven and Hell. They held ceremonies in his honor every winter solstice —then December 25, now December 21, because of the change in the Roman calendar. The Greeks adopted this worship, called Mithraism, and from them in turn, the Romans took it.

Early Christians found Mithraism their strongest pagan rival. Finally, when they succeeded in stamping it out in the third century, compromises forced the adoption of certain of its customs and days of worship. Jesus' birth date was unknown, but legend placed it at the year-end (because Joseph and Mary were then in Bethlehem to pay annual taxes to the Romans) and a celebration with Jesus (replacing Mithra) as the "light of the world" was particularly appropriate. The then winter-solstice, Dec 25, was fixed upon. In 534, Christ's Mass was recognized as a legal holy day.

Early Germans added the Yule feast, the singing of carols, and the legend of Santa Claus. They too, began to hang ornaments on the evergreen tree, which was simply the northern variation of the 12-branched (1 for each month) palm the Egyptians carried hundreds of years earlier in their winter-solstice worship of the god Isis. Plum pudding, mince pie, and the exchanging of gifts were early medieval customs that were finally centered on Christmas Day. The Italians contributed their annual Jan 6 custom of hanging a stocking for gifts (only ashes, if the child had been naughty) from the fairy Belfana, and England added the Yule log in 1577. Not until the latter half of the nineteenth century were Christmas cards introduced.

So we see that Christmas means something to all men, regardless of nation or creed. Man rises above the animals in one important characteristic, spirituality, or his belief in a higher power, be it on the surface or deep down inside of him. My investigation of its origins only strengthened my conviction that Christmas is the day when man forgets his petty hates and fears, when he joins with all other men since time began in the ageless wish for happiness, "Peace on earth and good will toward men."

May that age-old hope be my Christmas wish to you.

George Edwards

Engineer

Review of POWER *and* MECHANICAL EQUIPMENT

In the pages that follow, Power presents its tenth annual review of new and improved equipment. The 300 descriptions presented here are summaries of those which have appeared in Power since January 1, 1937

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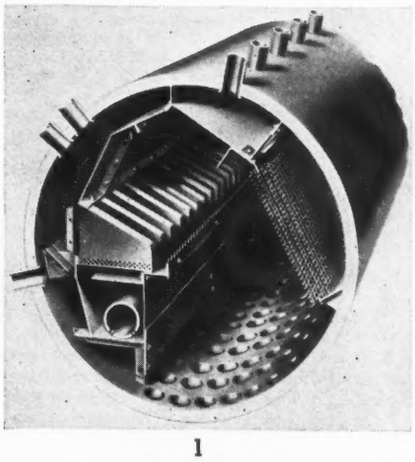
BOILERS, STOKERS, REFRACTORIES AND ACCESSORIES



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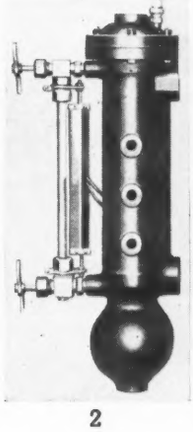

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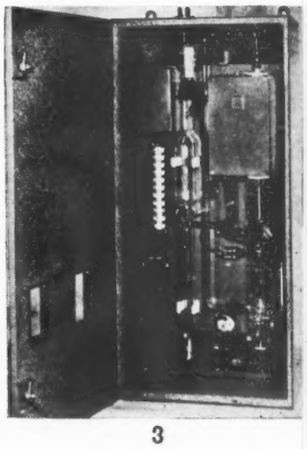

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1 STEAM WASHER — Entrained solids are removed from steam by forcing it to bubble through clean feedwater, which enters trough of washer through longitudinal perforated pipe and spills over notched weir. Steam entering drum through tubes is passed into hoods and out through apertures, bubbling through feedwater. Washing of steam is obtained also by mixing of steam and water between elements. Screen removes moisture that may be carried along with steam. *Combustion Engineering Co, Inc, 200 Madison Ave, New York, N. Y.*

2 NEON ILLUMINATOR FOR WATER GAGES—Neon-light tube and magnifying lens are attached behind water gage by two screw clamps which grip around top and bottom gage fittings. Water- or liquid-filled part of gage glass stands out as broad red band; empty space above appearing as hairline red stripe. *Wright-Austin Co, 315 W Woodbridge Ave, Detroit, Mich.*

3 WET-GAS CO_2 RECORDING EQUIPMENT—In 4 parts: (1) recorder, either strip- or circular-chart type. Measuring circuit operates on 110-volt, 60-cycle ac, range of 0 to 20% CO_2. Metal, vapor-proof case for flush mounting. (2) Gas-analysis cell cabinet (illustrated here). Includes cell for 0 to 20% CO_2, aspirator, metal cabinet and water saturator, gas-flow indicator, etc. (3) Primary filter and receptacle. (4) 40 ft of lead-lined sampling pipe and fittings. *Leeds & Northrup Co, 4902 Stenton Ave, Philadelphia, Pa.*

4 OVERFEED COAL STOKER—Coal from screw conveyors (in pipe) falls into hopper onto two revolving distributor heads operated through gears by small motor. Centrifugal force distributes coal over entire grate surface. Stoker may be swung away from heating plant to allow removal of ashes. Fully automatic. *Kirby Mfg Co, 238 S Union St, Decatur, Ill.*

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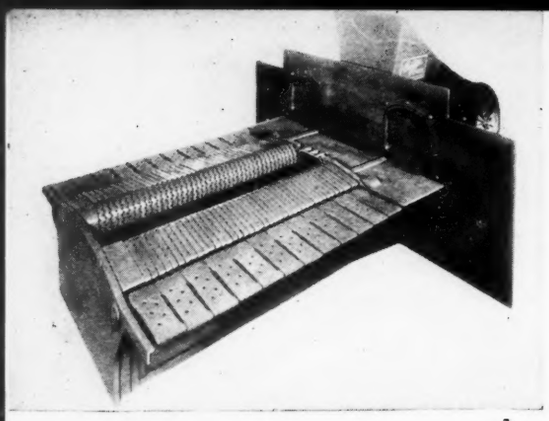

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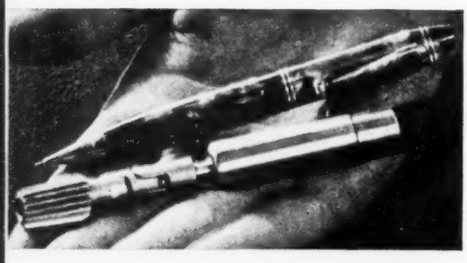

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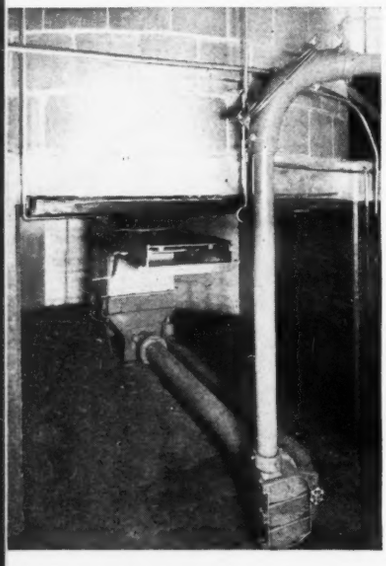

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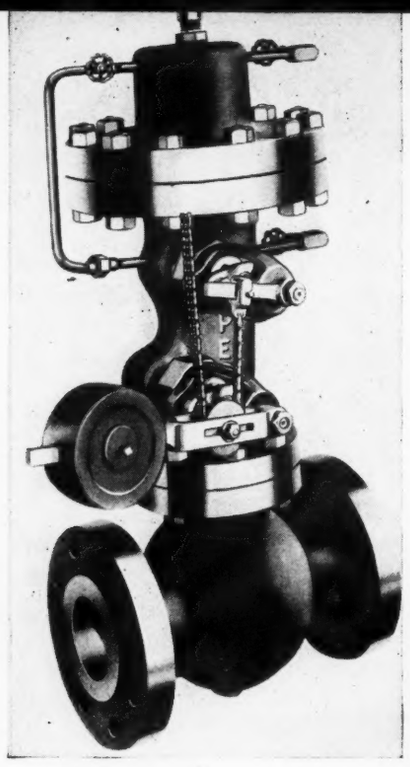

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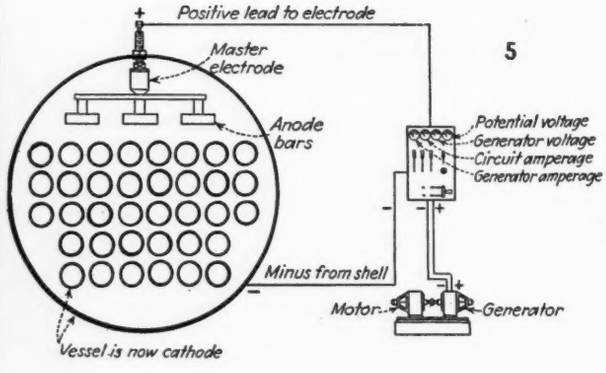

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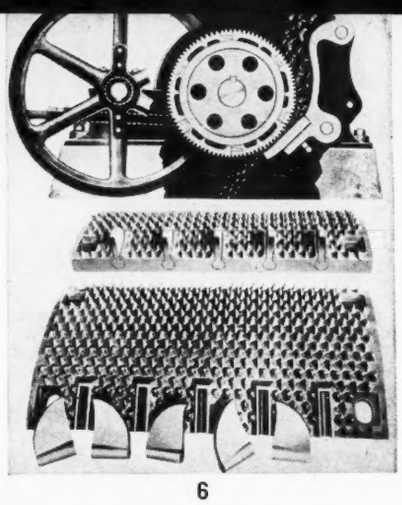

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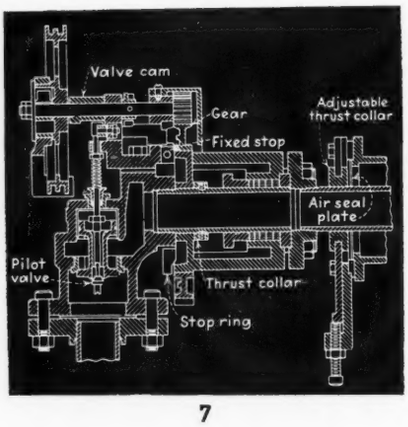

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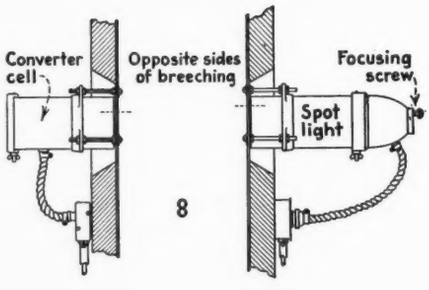

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1 UNDERFEED STOKER — Low-headroom ram, underfeed stoker is of all-metal construction, including windbox with sliding clean-out panels. Dust-proof gearbox has Timken bearings; motor mounted 24 in. off floor and connected with protective shield. Retort ram is adjustable while stoker is in operation; seven feed adjustments and unlimited air adjustments. *Canton Stoker Corp, Andrew Place SW, Canton, Ohio.*

2 TUBE CLEANERS—"600 Series" small-bore tube cleaners for condensers, heaters, heat exchangers, and marine boilers. Made in a range of motor diameters from 15/32 to 17/16 in. Air-driven motor, using rotor with 4 paddles, operates on pressure up to 100 lb and consumes from 10 to 30 cfm, depending on size. Will also operate on steam. Not claimed to remove heavy hard accumulation of scale, but will take off soft accumulation or a thin hard one. *Elliott Co, Jeanette, Pa.*

3 PNEUMATIC STOKER—Bin-feed spreader stoker conveys coal by high-velocity air from bunker to boiler. Bunker may be located 8 to 15 ft from boiler. Burns successfully coal of high ash content and of low ash-fusion temperature. Flat grates; moving parts not exposed to furnace temperature. *Iron Fireman Mfg Co, 3170 W 106th St, Cleveland, Ohio.*

4 FEEDWATER REGULATOR — 2-element steam-flow feedwater regulator feeds boiler according to rate of steam flow and provides water-level characteristics for best operating results on individual unit. A higher water level can be provided for heavy loads than on light, or practically constant level can be maintained for all ratings. Two control elements: (1) steamflow controller measures steamflow rate by taking pressure drop through superheater; (2) water-level thermostat, with tension expansion tube, responds instantly to changes on boiler-water level. Both are connected mechanically to feedwater-control valve so that valve is positioned by resultant of two forces. Sizes of 2 to 6 in. *Northern Equipment Co, Erie, Pa.*

5 CORROSION PREVENTATIVE—Based on theory that surfaces of boilers, heaters, and other metal surfaces, being anodic, are attacked electrochemically by presence of sulphates, carbonates, chlorides, etc, in water. Kirkaldy method reverses polarity of equipment and maintains all surfaces cathodic. *Electrolytic Metal Protection, Inc, 247 Park Ave, New York.*

6 SINGLE-ROLL CRUSHER — Designed for preparation of stoker and smaller-size coal, this unit has renewable segments which carry thin, sharp, pyramid and spear-point teeth; also insertable "Wejtite" feeder teeth for reduction of large coal. Manufacturer states that teeth, together with pattern of spacing, minimize degradation by causing piercing action rather than mashing. New breaker plate eliminates boiling of feed and increases capacity. *Jeffrey Mfg Co, Columbus, Ohio.*

7 SOOT BLOWER—Valve-operating mechanism is adjusted to open and remain open during blowing arc as soon as blower element has come into proper position. Valve housing can be removed without disconnecting head from element. Short pipe connections said practically to eliminate condensation and automatic air-check valves prevent acid formation and corrosion of parts. Chain, when pulled in one direction, opens valve; when pulled in opposite direction, rotates element. *The Bayer Co, 4067 Park Ave, St. Louis, Mo.*

8 SMOKE DETECTOR — "Smoke Sentry" rings bell and flashes red signal when inefficient combustion causes smoke. A beam of light from an "electric eye" on one side of breeching is focused on a light-sensitive cell on opposite side. With no smoke, there is no dimunition of light intensity, but a small quantity of smoke affects reaction on cell. An adjustable pointer indicates density at which signals start. *Boiler Room Equipment, Inc, 45 West 45th St, New York, N. Y.*

9 INSULATING BRICK—"JM-20" for use behind refractory walls and also for direct exposure at temperatures up to 2000 F where there is no flame impingement, slag action or mechanical abrasion. A combination of a high-quality refractory clay and a manufactured, fibrous, light-weight, inorganic aggregate. Weighs less than 1.7 lb per standard 9-in. equivalent. *Johns-Manville, 22 East 40th St, New York, N. Y.*

10 SELF-CONTAINED BOILER — Small, self-contained boiler for automatic operation made in three sizes for evaporation of 500, 800 and 1200 lb of water per hr. Pressure range from 50 to 1000 lb per sq in., with total steam temperatures up to 850 F. Oil fired under automatic regulation with electric ignition. Natural-circulation water-tube boiler has two drums, and furnace is formed by extension of two rows of tubes. Tests at operating pressures from 275 to 500 lb ranged from 81.2 to 83% based on heat content of 19,300 Btu per lb of oil. *Steam Motors, Inc, Newton, Mass.*

11 BOILER-RETURN SYSTEM—"No-Vent" return system is designed to return condensate directly to boiler at practically same temperature and pressure as steam entering steam-heated cookers and driers initially. Centrifugal pump operates continuously whether condensate or steam happens to be in casing, without damaging pump. System eliminates vent (high-pressure flash steam) and divorces high-pressure steam circuit from all low-pressure exhaust steam. *David Stout & Sons, Inc, 406 Market St, St. Louis, Mo.*

12 BLOWER UNIT—For forced-draft of either hand-fired, stoker-fired, oil- or gas-fired boilers, or for secondary air supply to pulverized-fuel-burning boilers, this blower obtains pressures of 6 or 7 in. wg by 2-stage combination. Self-contained unit consists of constant-speed electric motor with double-extended shaft; two propeller fan wheels, one mounted on each shaft; integral damper control and air redirecting mechanism built in between fan wheels. *L J Wing Mfg Co, 154 W 14th St, New York, N. Y.*

13 PROPORTIONING FEEDER—"Model B Junior" feeder has sight feed indicator and operates on fluid-piston principle. *A* filled with an inert hydrocarbon colored red; *B* with reagent solution. In response to pressure difference between pitot tubes, proportionate quantity of water rises into *A* and into upper gage fitting, where water drops through oil in glass one drop at a time. Oil is displaced from *A* across a needle valve into *B*, causing reagent to flow into discharge pitot tube. 5-gal. capacity. Also made as 3-tank unit for proportioning two reagents. *D W Haering & Co, Inc, 3408 W Monroe St, Chicago, Ill.*

14 FEEDWATER-LEVEL CONTROL — When water level drops in gage glass, water runs down inclined tube, which is exposed to temperature of steam at boiler pressure. Expansion of tube causes end casting to move upward and open valve. When water rises in gage, cooling action of water causes contraction which lowers end casting and closes valve. Automatic, will operate on any valve up to 12 in., over-all length 48 in. *J A Campbell Co, P O Box 851, Long Beach, Calif.*

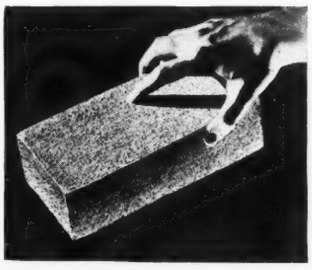
15 CHAIN-DRIVE STOKER — Bin-fed stoker for boilers up to 2500 sq ft. Designed for use where maximum clearance is needed in front of boiler. Gear case and fan unit mounted next to wall of fuel bin. Power from motor is transmitted by shaft to back of unit, where chain drive connects shaft and feed worm. *Iron Fireman Mfg Co, 3017 W 105th St, Cleveland, Ohio.*

16 FLUE-GAS METER—"Fuel-Ratiometer," for measuring CO_2 and stack temperatures, has 4-high resistant wires in a Wheatstone-Bridge circuit—two in an air-surrounded cell, two in analyzing cell open to gas flow. If CO_2 envelops 2 filaments in analyzing cell, rate of heat traveling from filaments is slower through CO_2 than air, resistance increases because filament becomes hotter, and current starts to flow in bridge circuit in one direction. Resistance change is calibrated by meter to read in direct percentage CO_2. *Wm O Hebler Co, 830 Broad St, Newark, N. J.*

17 PORTABLE CO_2 INDICATOR—"Ranarex" determines CO_2 by mechanical principle that specific weight of flue gas varies with changes in CO_2 content. A motor-driven fan imparts rotating motion to flue gas and blows it against blades of an impulse wheel, thus producing a torque on impulse-wheel shaft in proportion to CO_2 content. Changes in fan speed, temperature, humidity and atmospheric pressure are automatically compensated for by a comparing torque produced on another impulse wheel driven by the same motor. Two impulse wheels are coupled by a balancing linkage which actuates indicator. *Permutit Co, 330 W 42nd St, New York, N. Y.*

18 CHAIN-GRATE STOKER — Self-contained stoker for small boiler units has variable-speed drive with constant-speed motor, 3-speed spur gear driving unit, removable hopper apron, individual damper control for each air compartment, feed-gate indicator, side-wall access door, adjustable front and rear shafts, large hopper capacity. Full automatic control furnished when specified. *McClave-Brooks Co, Scranton, Pa.*

CONDENSATE RETURN—Latest model "Return-to-Boiler" system embodies two improvements: a submerged tube for returning hot condensate below water line and a secondary switch in the receiving tank, which starts pumps and motor, and sounds an alarm if condensate rises too high. Latter in addition to master switch regulating water level. *Kisco Boiler & Engineering Co, 4333 Duncan Ave, St. Louis.*



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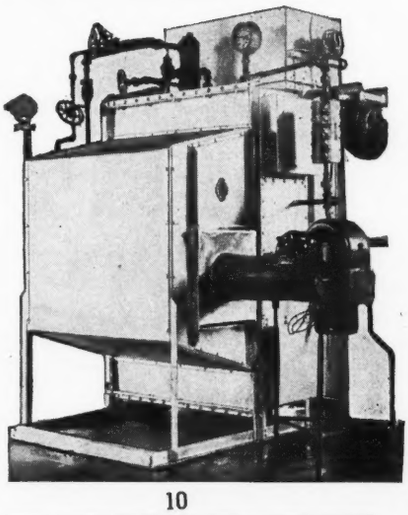

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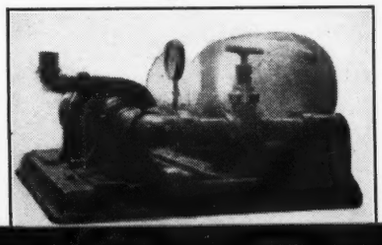

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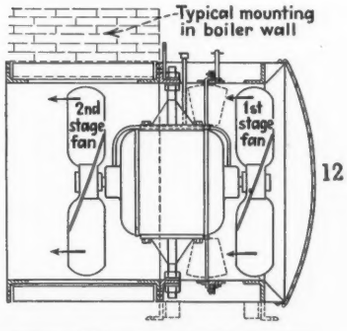

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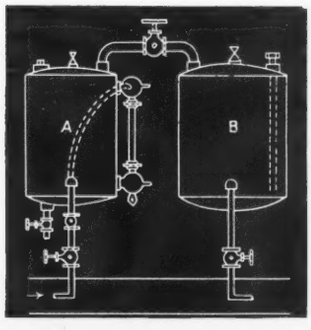

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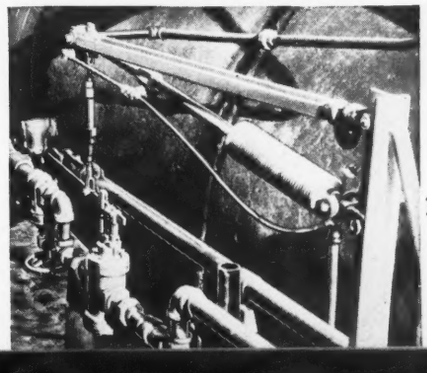

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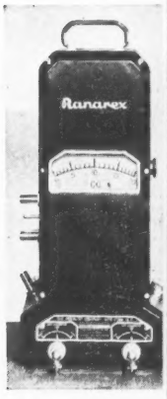

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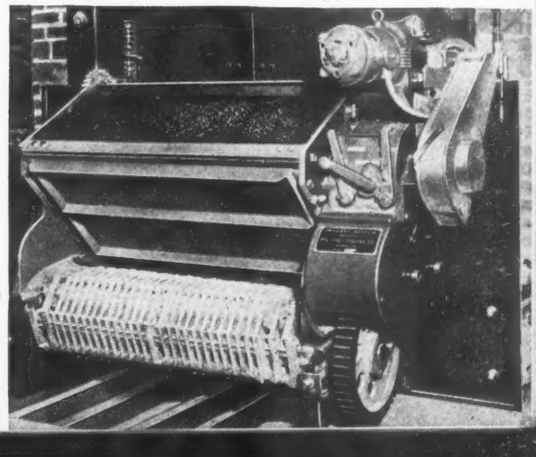

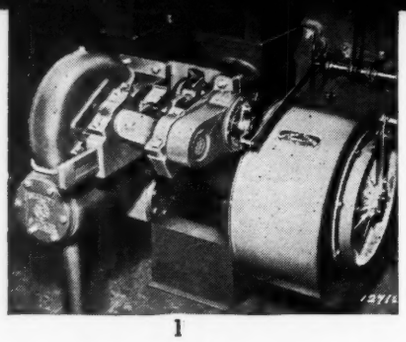

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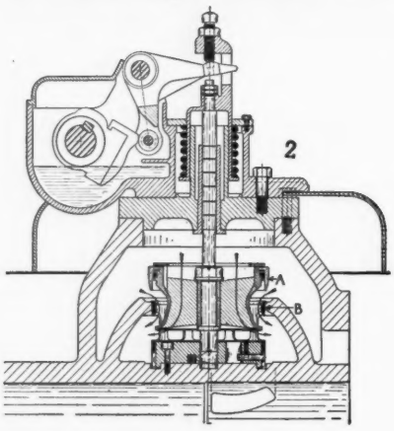
1 ADJUSTABLE FEED FOR STOKER—May be applied to new or existing Detroit single-retort stokers and "Unistokers" to provide a large number of positive rates of feed coal to stoker. retort. Unit is built into right-hand crankshaft bracket of stoker; is either manually or automatically controlled. Master regulator of adjustable feed may be connected to damper at fan inlet to synchronize air supply with fuel feed, or may be connected to boiler uptake damper. *Detroit Stoker Co, General Motors Bldg, Detroit, Mich.*



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2 POPPET-VALVE GEAR—New and simplified poppet-valve gear for variable-speed steam engines adds to regular valve gear a sliding cutoff sleeve with ports in periphery surrounding poppet valve. By simply changing elevation of cutoff sleeve by automatic control, governing rate of flow from a compressor or pump attached to engine, speed can be varied or kept constant. Can also be manually operated. In cross-section, *A* is upper seat of standard expansion-compensating poppet valve used on all "Universal Uniflow" engines, valve being open, *B* is cutoff sleeve in its lowest position, lower edges of ports in sleeve being on same plane with cylinder seat for valve. *Skinner Engine Co, Erie, Pa.*

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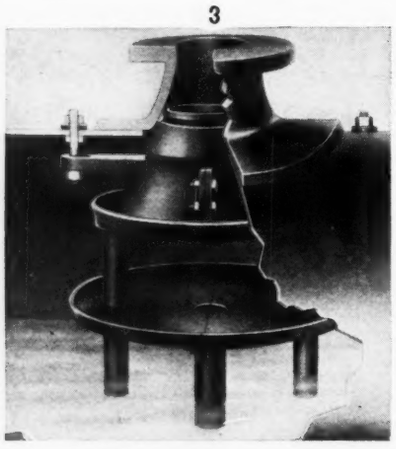
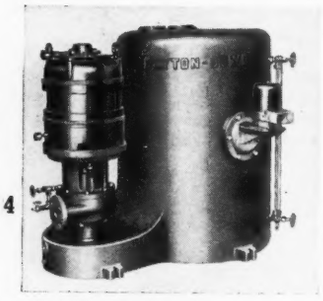


3 STEAM SEPARATOR—"Interceptor" is made in sections to allow entrance through boiler manhole. Designed to permit steam flow through interceptor with minimum friction, as all openings are larger than steam-outlet pipe and nozzle is flared at bottom with gradually reduced area down to size of pipe. Annular-shaped trough surrounds bottom of bell-shaped inlet nozzle to intercept any water which might be carried by friction into steam pipe. *Hoppes Mfg Co, Springfield, Ohio.*



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4 CONDENSATE-RETURN PUMP—Bronze-fitted, close-coupled vertical pump is flange-mounted to a vertical cast-iron receiver tank equipped with syphon float-switch gages and tapped opening. 30-, 50-, or 80-gal. tanks with appropriate pumps. *Dayton-Dowd Co, Quincy, Ill.*

CO_2 NEUTRALIZER—Corrects corrosive action in steam and condensate-return lines by absorbing CO_2. "Corravol," a volatile substance, is added to boiler water, and makes complete cycle. Continuous regeneration. *Western Chemical Co, 713 Washington St, Kansas City, Mo.*

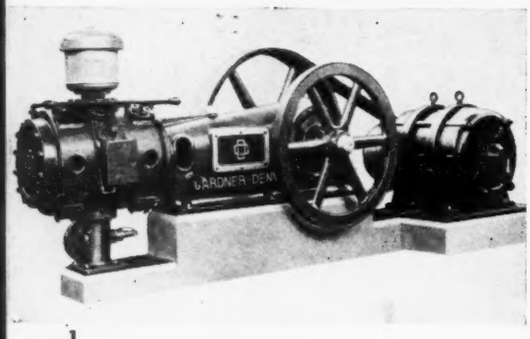
PORTABLE pH METER—Two models, one with simple potentiometric circuit and either quinhydrone (for acid determinations) or antimony electrodes (for alkaline determinations), or complete with both sets of electrodes. Other model has vacuum-tube amplified potentiometeric circuit with either quinhydrone, antimony, glass electrodes, or all three. *Thwing-Albert Instrument Co, Philadelphia, Pa.*

COAL VALVE—Bodies of "Seco" coal valves fabricated from ⅜-in. steel plate by electric welding and grinding. Gate is driven by protected double-rack and pinions to eliminate binding. Gate and pinion shaft are mounted on ball bearings with grease fittings. *Stock Engineering Co, Penton Bldg, Cleveland, Ohio.*

REFRACTORY INSULATION—For backing up firebrick and waterwalls, "Insulblox," a block, and "Insulag," a plastic, have an approximate heat-storage capacity of 1/40th. Temperatures to 220 F. Water added to "Insulag" makes it applicable plastic which does not shrink on drying. *Quigley Co, 56 W 45th St, New York, N. Y.*

ZEOLITE WATER SOFTENER—2-flow softener has two tanks. Hard water enters at bottom of one flows up through Zeolite and over through a pipe into second tank, through a second Zeolite bed, and emerges as soft water. 2-flow unit provides faster flow rate, lessens amount of water required for backwashing, and had a higher salt efficiency which effects a saving in Zeolite. *Elgin Softener Corp., Elgin, Ill.*

COMPRESSORS, BLOWERS AND FANS



1

1 HEAVY-DUTY AIR COMPRESSOR—For heavy-duty, full-load service, single-stage horizontal "R X" compressor has enclosed dust-proof construction. "Electro-Pneumatic" control starts compressor when unloaded and automatically adjusts air supply to fit load for economical part-load operation. *Gardner-Denver Co, Quincy, Ill.*

2 STATIONARY AIR COMPRESSOR — "Utility" compressor designed for industrial plants. Mechanical intake valve in compressor block is operated from camshaft in timing with piston travel; main bearings intersperse every cylinder; force-feed lubrication. Manufactured for either V-belt drive or direct coupling to electric motor. Size range of 85 to 420 cfm air delivery. *Schramm Inc, West Chester, Pa.*

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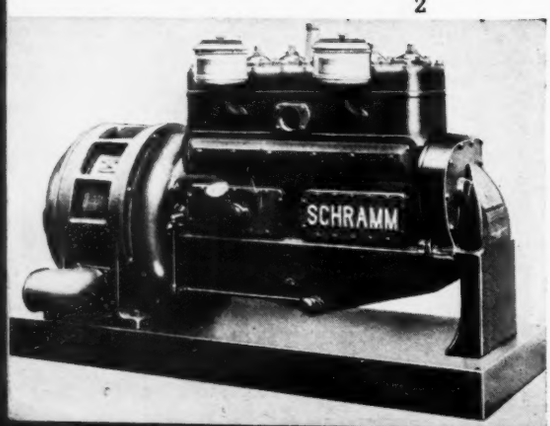

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3 AIR COMPRESSORS — "Utility" compressor for belt drive made in seven sizes ranging from 120 to 630 cu ft. Unit includes compressor, 1800-rpm motor, short V-belt drive and vertical air receiver mounted on single-frame base. Force-feed lubrication, mechanically-operated intake valve, discharge valve occupying full head area, and water cooling. All sizes adaptable to installations with or without motor or air receiver, and with belt drive or built-in direct motor drive. *Schramm Inc, West Chester, Pa.*

4 DIESEL-DRIVEN COMPRESSOR — Two models, stationary and portable (stationary in illustration). Model WO-2 portable unit consists of CP Type 48 vertical, 4-cyl, 4-cycle, medium-speed diesel on common crankcase and crankshaft with V-type 2-stage, double-acting, water-cooled compressor, with cooling system and air receiver, all on structural-steel deck, arranged for mounting on skids or wheels. Capacity of 700 cfm. Stationary model W-CO

uses same engine and compressor as WO-2, but is arranged for mounting on permanent foundation or skids. Sizes of 3 or 4 engine cylinders, rated 112½ and 150 hp respectively, with 2-stage compressor cylinders, having piston displacements of 655 and 830 cfm, respectively. *Chicago Pneumatic Co, 6 E 44th St, New York, N. Y.*

5 DIESEL-POWERED COMPRESSOR—Self-contained diesel-driven, 210-cfm air compressor made with several types of portable and semi-portable mountings. Model 36-A, 4-cycle, 6-cyl, medium-high-speed diesel direct-connected to light-weight water-cooled compressor. Unit designed to permit easy inspection and servicing. Unit is available with several types of mounting: wooden skid, steel wheel, solid or pneumatic rubber-tired wheel, 4- or 2-wheeled trailer, and motor or railway truck. Illustration shows unit with pneumatic-tired, 4-wheel portable mounting. *Fairbanks, Morse & Co, 900 S Wabash Ave, Chicago, Ill.*

6 ANTI-FREEZE FOR AIR LINES—"Tanner Tank" air-line anti-freeze system is harmless, odorless, and non-explosive. Non-injurious to metal, hose or lubrication. For pressures up to 200 lb. Guaranteed to —70 F. *Sullivan Machinery Co, Woodland Ave, Michigan City, Ind.*

7 FRACTIONAL-HP COMPRESSOR—Made in ¼- and ½-hp sizes with automatic start-and-stop control, seamless-steel tank, and new type check valve. For single-phase current, compressors have brushless capacitor motor and built-in automatic protection against overload and under-voltage. Rated 150 lb per sq in. maximum pressure. 2.4-cu ft tank for both sizes or 4.6-cu ft tank for ½-hp size in either vertical or horizontal mounting. *Ingersoll-Rand Co, 11 Broadway, New York, N. Y.*

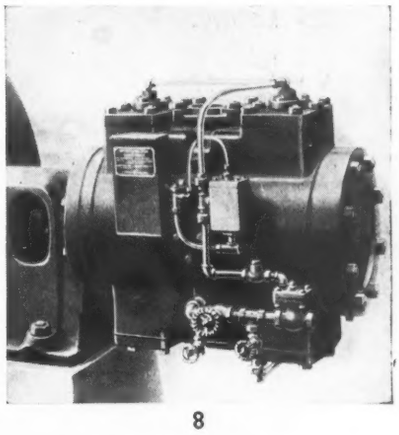
8 START-STOP CONTROL AND UNLOADER—Automatic start-and-stop control plus automatic loading and unloading for motor-driven, single horizontal compressors can be obtained with magnetic unloader without extra piping or valves. Device operates on standard electric equipment and can be installed wherever conventional electric starter is used for controlling compressor motor. There must also be a pressure switch to operate pilot circuit. Pressure-switch control is transferred electrically from motor starter to magnetic unloader, and either position may be selected at will. *Worthington Pump & Machinery Corp, Harrison, N. J.*

9 AIR COMPRESSOR—For heavy-duty service, Class WN-112 compressor will operate on any type drive, but said to reach greatest efficiency with built-in motor. Displacement sizes of 378, 480, 642 and 800 cfm. "Dual-cushion" valves, alloy parts. With built-in motor, unit requires 6x8 sq ft floor space. *Sullivan Machinery Co, Woodland Ave, Michigan City, Ind.*

10 MOTOR-COMPRESSOR UNIT—Compressor crankshaft carries motor rotor, and compressor frame carries motor stator. Intercooler and radially-placed cylinders are air cooled. Flexible coupling and V-belt drive also available. Size range of 15 to 75 hp for discharge pressures from 80 to 125 lb per sq in. Piston displacements range from 79 to 445 cfm. *Ingersoll-Rand, 11 Broadway, New York, N. Y.*

11 GAS-ENGINE COMPRESSOR — Type LCE 4-cycle, angle-type gas-engine compressor designed as medium-sized, self-powered unit for processing needs of refineries and natural-gasoline plants, gas-transportation lines, gas- or air-lift pumping, refrigeration, etc. One to four compressor cylinders (75 to 300 hp); all compressor cylinders are horizontal and at right angles to power cylinders. Each compressor cylinder has two corresponding power cylinders, and compressor element can be arranged to deliver any combination of volume and pressure within limits of engine rating. Force-feed lubrication with deep oil sump at engine base; separate lubricator for cylinders. *Worthington Pump & Machinery Corp, Harrison, N. J.*

NON-LUBRICATED AIR COMPRESSORS—For special process work where oil in compressed-air supply is objectionable. Oil-less cylinder construction available in two single-stage compressors; WGO-8 for belt drive and WAO-8 for steam drive. Self-lubricating rings and honed cylinder liners require no oil. Double-row tapered-roller main bearings, replaceable thin-steel connecting-rod bearings, and removable-liner crosshead guide of special cast alloy. *Sullivan Machinery Co, Woodland Ave, Michigan City, Ind.*



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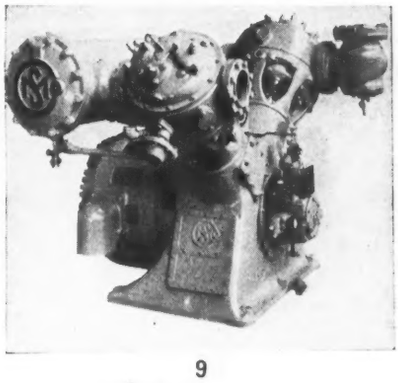

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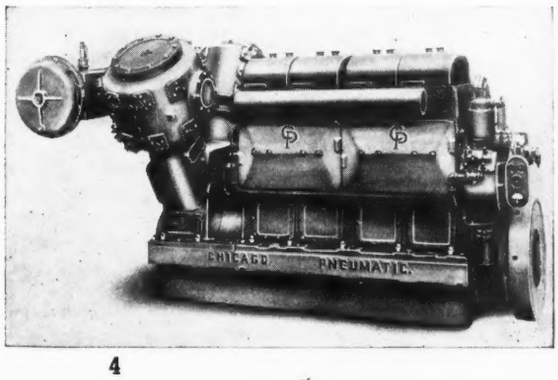

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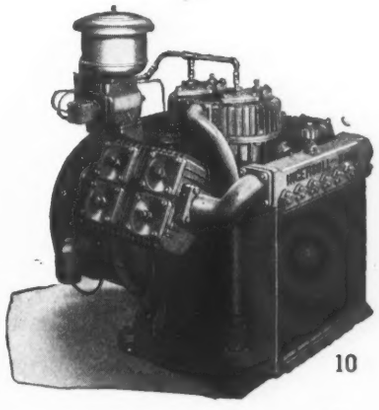

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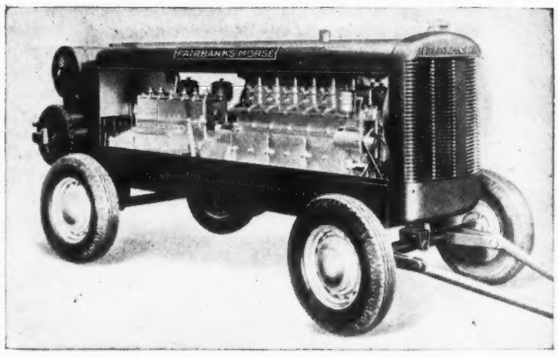

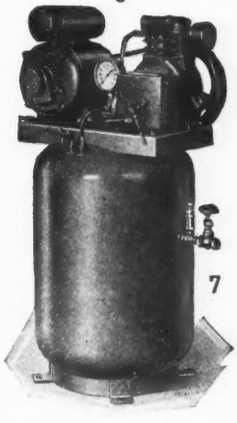

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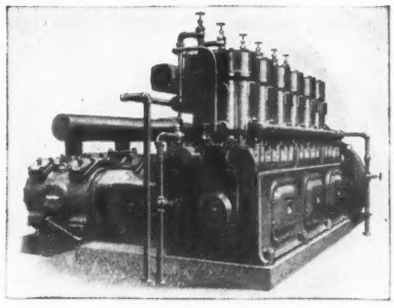
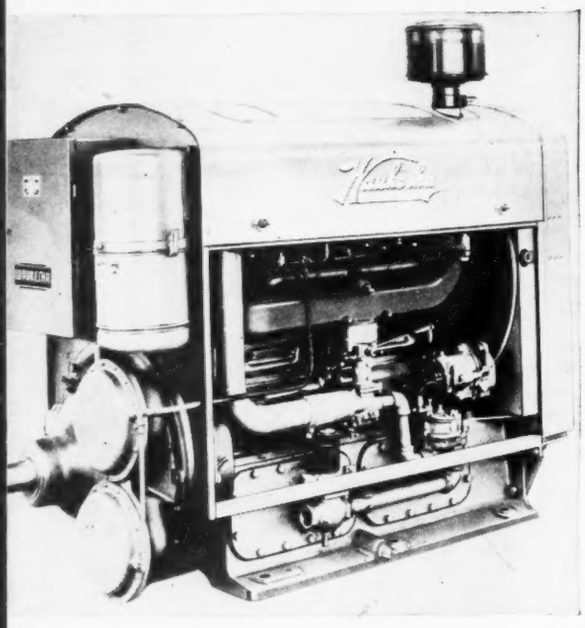


DIESELS, GAS ENGINES AND ACCESSORIES



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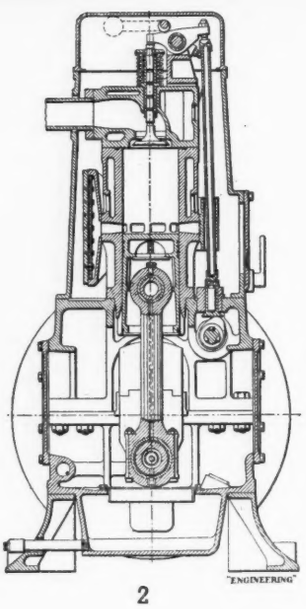

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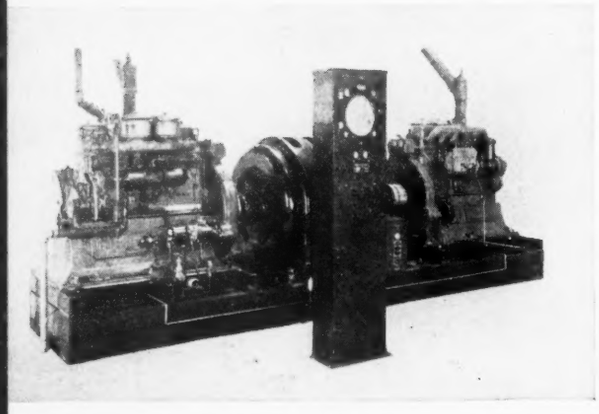

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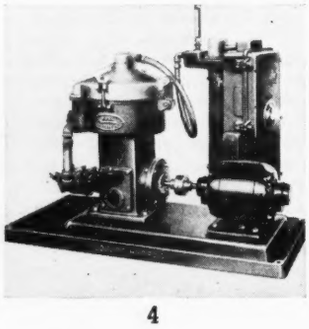

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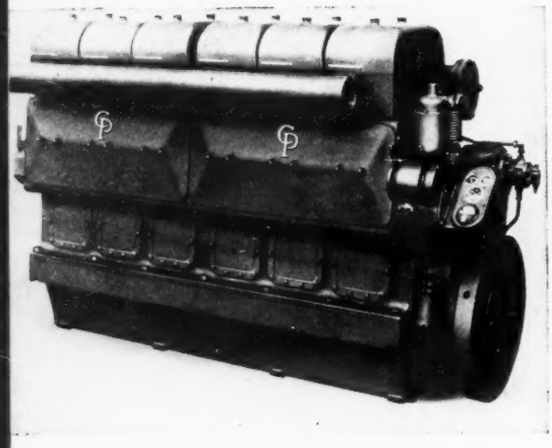

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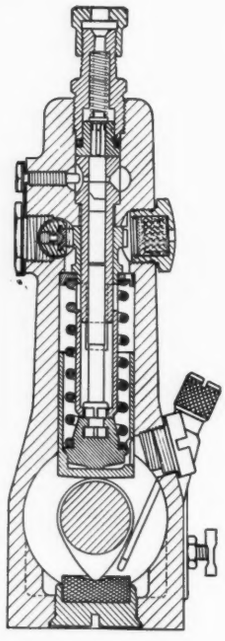

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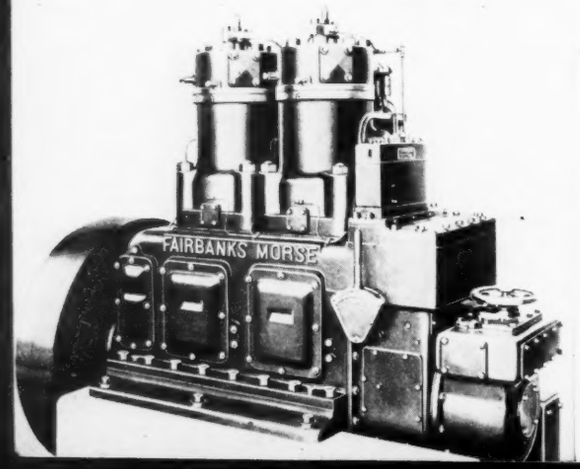

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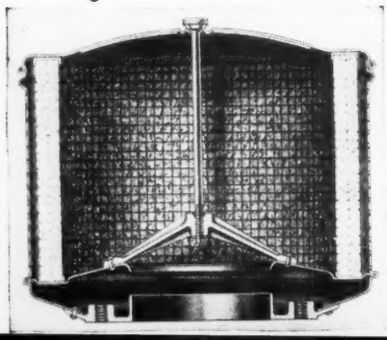

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1 AUTOMATIC POWER UNIT — Heavy-duty, high-compression, 4- or 6-cyl gas engine with flat-bed mounting, sheet-steel enclosure, centrifugal built-in governor, and gas carburetor are all conventional. Clutch and power take-off, however, have special vacuum-operating mechanism that permits engine to start and attain full governing speed before load is applied; will also declutch if overload tends to reduce engine speed below predetermined limit. Control box contains master switch, safety switches and time-cycle switch. *Waukesha Motor Co, Waukesha, Wis.*

2 2-CYCLE DIESEL—"Harmonic Induction" engine is uniflow, 2-cycle, airless-injection, 4-, 2- or single-cyl, with exhaust valve central in cylinder head. Inlet air ports, arranged circumferentially around cylinder, open when piston is at bottom of stroke. Air enters cylinder at lower end, is compressed to upper end, and is exhausted from that end, making air flow always in same direction. When exhaust valve opens, sudden ejection of burnt gas sets up a wave in exhaust pipe, which is followed by a wave of rarefaction. Low-pressure or partial-vacuum waves are synchronized with opening of air ports, resulting in complete scavenging by inrushing air. 4½-in. bore, 6½-in. stroke, develops 18 bhp per cyl at 1000 rpm. *Petters, Ltd, Yeovil, England.*

3 AUTOMATIC DIESEL CONTROL—Three standardized units have been developed in sizes 45, 90 and 140 kw, each consisting of one double-ended, 1200-rpm generator driven by two diesels through automatic over-running clutch couplings. A dual air-operated "Tecomatic" exhaust-temperature recorder controller is furnished for each unit, providing automatic control and daily log of each engine operation. Any number of units can be operated in parallel to govern a multiple-unit plant of any capacity. In multiple-unit ac application, generators float on line as synchronous condensers when not operating as generators. *Thermal Engineering Co, 716 Columbus Ave, Boston, Mass.*

4 OIL PURIFIER—For diesel engines, "400 Series" centrifugal oil purifier is made in three sizes for diesels up to 12,000 bhp, and range of 30 to 100 gal. of lubricating oil per hr. As fuel-oil purifier, has capacity from 50 to 125 gpm. *Goulds Pumps, Inc, Seneca Falls, N. Y.*

5 HEAVY-DUTY DIESEL—Type 8 CP, designed for continuous heavy-duty service, is 4-cycle, direct-injection engine. 3, 4, 6 or 8 cylinders deliver 90 to 300 hp at 600-720 rpm. 8-in. bore, 10½-in. stroke. Bosch fuel pump. Base and A-frame alloy-iron castings; die-pressed and heat-treated crankshaft. *Chicago Pneumatic Tool Co, 6 E 44th St, New York, N. Y.*

6 FUEL-INJECTION PUMP — Two models for 1-, 2- and 6-cyl diesels. High-speed, solid-injection, helical-plunger pumps operated by constant-velocity cams. At low position of plunger, cylinder receives oil charge from feed line, and as piston covers inlet port, fuel delivery starts and ends when upper helical edge of annular piston groove opens bypass port, releasing pressure to discharge line. Delivery regulated by turning piston in cylinder to vary point of delivery stroke in which bypass port in uncovered. *Timken Roller Bearing Co, Canton, Ohio.*

7 HEAVY-DUTY DIESEL—Model 42-E has mechanical injection and crankcase scavenging. 2 and 3 cyl, 60 and 90 hp, 450 rpm, 8¾-in. bore, 10½-in. stroke. Direct connection, belt or electric-generator drive. Designed for limited space and head room. *Fairbanks, Morse & Co, 900 S Wabash Ave, Chicago, Ill.*

8 AIR CLEANER — "I-F Series" intake-air cleaner has filter of wound copper gimp

coated with viscous fluid. As intake air flows through winding, air is forced into repeatedly changing passes; dirt and grit clinging to oily surfaces. Large gimp windings provide several weeks of operation without rechanging. Capacities up to 3150 cfm at maximum velocities to 4000 fpm. *Burgess Battery Co, Acoustic Div, 111 W Monroe St, Chicago, Ill.*

9 OIL PURIFIER—For purifying fuel or lubricating oil where electric power is not available, gasoline-engine-driven centrifugal purifier has "300 Hydroil" unit mounted on drip bedplate with Briggs & Stratton 4-cycle engine. Capacity up to 450 gal. fuel oil and 300 gal. lube oil per hr. *Goulds Pumps Inc, Seneca Falls, N. Y.*

10 FUEL-OIL FILTER—"Fulflo" filter constructed of cotton yarn and wound into tube form upon a metal core. Filter tube is mounted on two seat plates having patented recessed centre which seals both ends to prevent bypassing of unfiltered oil. Tube assembly is held in place in filter shell by spring tension to compensate for varying pressures. Filter-tube replacements can be made in less than a minute by unscrewing ring which attaches shell to filter body. *Commercial Filters Corp, 89 Broad St, Boston, Mass.*

11 LUBE-OIL FILTER—"Stream-Line" filters have several packs made up of hundreds of specially-treated paper disks under spring pressure. Oil passes between disks, leaving separated solids and moisture on outer edges. Filter is cleaned by air pressure back through unit, draining impurities from base plug. Filtering packs said to last many months without replacing. *Skinner Purifiers Inc, 2231 Dalzelle St, Detroit, Mich.*

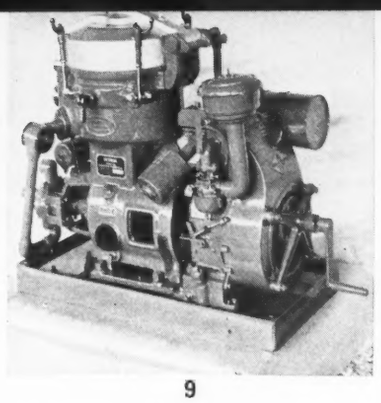
12 PYROMETER—"Alnor" Type 3023 pyrometer has self-contained selector switch for measuring exhaust temperatures of small diesels. Selector switch in either 2, 4, 6, 8, 10 or 12 points. Scale range of either 600, 800, 1000, 1200 or 1600 F. *Illinois Testing Labs, Inc, 420 N LaSalle St, Chicago, Ill.*

13 PYROMETER—Three models, for ranges from 0 to 1000, 0 to 1200, and 0 to 1600 F, have 4, 6, 8, 12, 16 or 24 switch points. Integral dial-type switch, molded-Bakelite water-proof case. Very rugged and resistant to vibration. *Brown Instrument Co, Philadelphia, Pa.*

14 INCLINED-DISK DIESEL—Model CD-425, crankless, opposed-piston, 2-cycle, solid-injection diesel. Develops 150 hp at 1200 rpm. A compressor introduces into cylinders a flow of air under a pressure of 3 to 4 lb per sq in. to blow out all burned gas and provide air for compression and combustion. Bendix electric starter, force-feed lubrication, 4¼-in. bore, 5 7/16-in. stroke, 4 cyl. Cover design by Count Alexis de Sakhnofsky. *Sterling Engine Co, Buffalo, N. Y.*

15 CONVERTIBLE DIESEL—Type D, vertical, 4-cycle, solid-injection diesel engine, convertible to natural gas. 2, 4 or 6 cyl for ratings of 50, 100 or 150 hp respectively. Bosch unit fuel pumps, one per cyl, and injection nozzles. To convert to gas, spark plugs are inserted in place of fuel injectors, a magneto installed which drives off same shaft as fuel pump, and air-intake manifold added equipped with natural-gas mixing valve. Two men can make conversion in one day. *Western Engine Corp, Los Angeles, Calif.*

16 AIR FILTER—New feature of this filter is backfire valve which eliminates relief valves on intake-pipe elbows. Interior construction follows general "Air-Maze" principles. When air is drawn under hood edge and passes down skirt, oil in pump automatically washes filter element made of alternately placed flat and crimped galvanized screens. Hood fitted with complete backfire valve. For capacities of 450 to 4000 cfm of air. *Air-Maze Corp, 812 Huron Rd, Cleveland, Ohio.*



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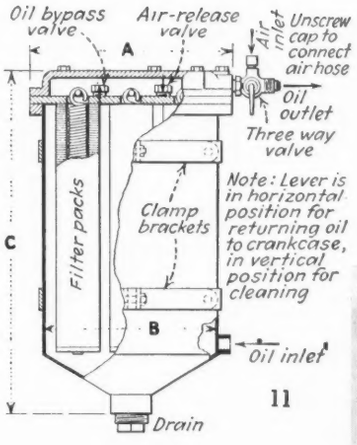

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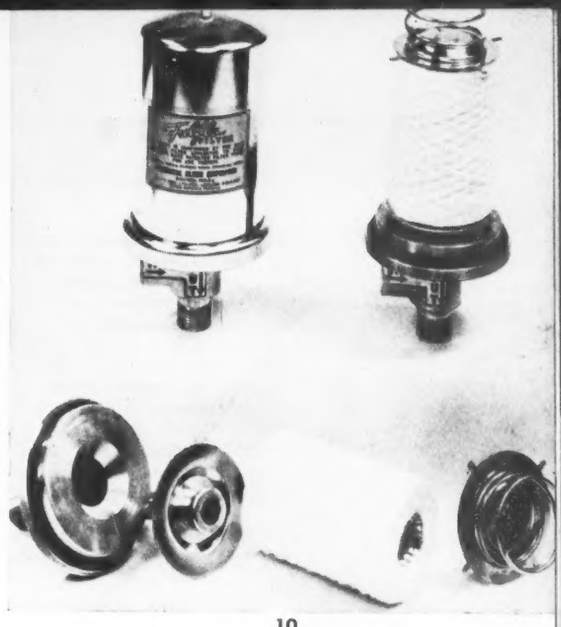

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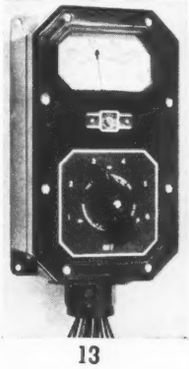

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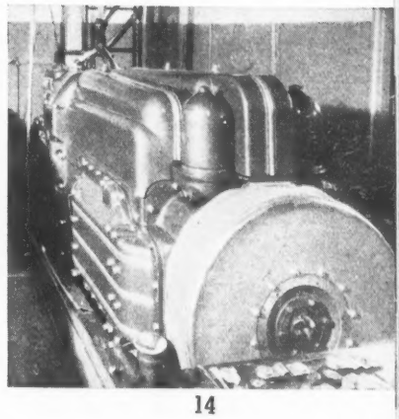

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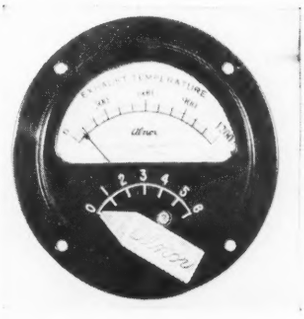

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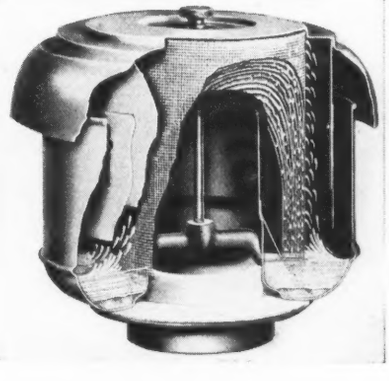

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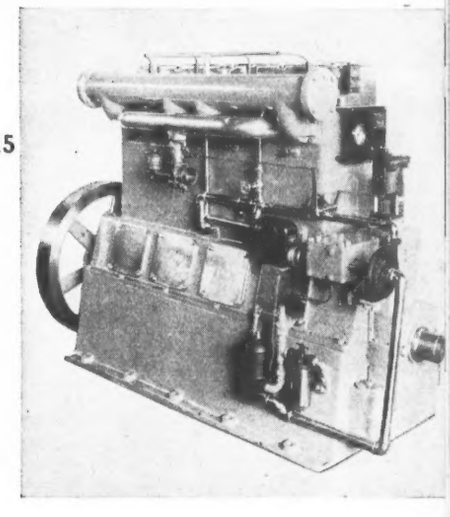

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OIL-RELAY SPEED CONTROL — Governor with chain-drive sprocket completely equipped for remote control with emergency hand trip and solenoid-actuated safety shutdown. Integral remote control, automatic safety shutdown and other refinements optional. Component parts, made in quantity lots, give over 10,000 possible assembly combinations. Load changes on prime mover cause small change in speed (less than 0.001% variation claimed), which is momentary and self correcting. *Pickering Governor Co, Portland, Conn.*

FUEL - OIL NEUTRALIZER — 5-plate unit neutralizes acid in fuel oil and makes harmless any moisture carried in suspension. As moisture and acid in oil come in contact with plates, a battery action takes place. A small electric current is generated, and as acid eats away special alloy plates, it is neutralized. Water settles to bottom of 7x13-in. container from where it can be drained. 35,000 to 40,000 gal. of oil may be passed over plates before new ones need be installed. *Cunningham Co, 4252 Santa Monica Blvd, Los Angeles, Calif.*

SCALE-REMOVER — "H-O-H" special cleaner, an acid compound, for rapid removal of scale in diesel jackets where it is possible to circulate a solution. *D W Haering & Co., Chicago, Ill.*

HEATING, VENTILATING, REFRIGERATION AND AIR CONDITIONING

1 AIR HEATER—Air is drawn through bank of extended-fin U-bend coils by multi-blade fans. Externally-mounted motor direct-connected to fan shaft through flexible coupling. Made in 7 standard sizes, each in three different assemblies: upright for floor mounting, horizontal for overhead suspension, and inverted for overhead or sidewall suspension. *Airtherm Mfg Co, 1474 S Vandeventer Ave, St Louis, Mo.*

2 SPACE HEATER — Ceiling-mounted unit heater has 2-row circular coil between two circular plates. Upper plate is supporting backbone of unit and carries motor. Lower plate provides orifice for fan. In operation, warm upper air is drawn through circular coil at low velocity and projected down to floor by 4-blade propeller fan with initial high velocity. Operates on either high- or low-pressure steam. *Trane Co, LaCrosse, Wis.*

3 ROOF VENTILATOR — Rotary ventilator has stainless-steel, fully-enclosed, dust-tight, oilless ball bearings upon which head turns with wind. Interior construction of streamlined steel tubing made into 1-piece head frame. Throat diameter sizes from 12 to 72 in. Oversize outlet for extra capacity under all operating conditions. *Swartwout Co, 18625 Euclid Ave, Cleveland, Ohio.*

4 REFRIGERATING UNIT—For both air-conditioning and refrigerating service, low-pressure unit employs either freon or methyl chloride as refrigerant. V-type compressor, from 4 to 8 cyl, depending on capacity, mounted on welded-steel base. Light-weight, feather type suction and discharge valves. Multi-V electric motor drive. *Carbondale Div, Worthington Pump & Machinery Corp, Harrison, N. J.*

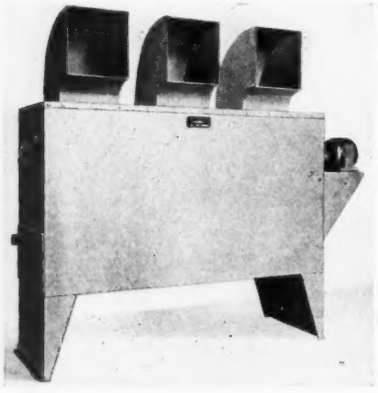
5 AIR COOLER—For cooling air or other gas for turbine-generators, synchronous condensers, water-wheel generators, etc. Shell consists of two steel plates, edges of which are bent to form a rigid channel, and which are fastened by cross members welded to sides of cooler. Water boxes of copper-bearing steel; cooling surface of Admiralty metal tubes. *Westinghouse Electric & Mfg. Co, East Pittsburgh, Pa.*

6 FIN COIL—Refrigerating coil made on order to fit individual specifications in fin sizes of 3 x 3 in. with fin spacing of ⅜, ½ and ¾ in.; also in fin sizes of 1¾ x 1¾ in. with fin spacing of ⅜ and ½ in. All coils made with ⅝-in. refrigerant tubing. With exception of copper tubing, all coil parts are aluminum. Separate return bends avoided to eliminate possibility of leaks. *York Ice Machinery Corp, York, Pa.*

7 AIR CONDITIONER—Does the complete air-conditioning job: cooling, dehumidifying, heating, humidifying, cleaning and air circulation. Available in sizes from 300 to 11,000 cfm, in refrigeration capacities from 2 to 50 tons, with or without humidifying and heating elements. Copper-finned coils, heavy welded-steel casings, quiet fans, self-cleaning hygrostat-controlled spray nozzles. *Worthington Pump & Machinery Corp, Harrison, N. J.*

8 ELECTRIC VALVE—For control of water to air conditioners and humidifiers, Type H valve has special method for attaching BX cable. Lower half of coil housing is empty, which allows wires from BX cable to be pushed into this space after connections are made to coil leads. *Supreme Electric Products Corp, Rochester, N. Y.*

9 BLAST HEATER—For heating, ventilating, air-conditioning and process applications, this blast heater has patented expansion bend to allow each tube to expand and contract without affecting adjacent tubes. Seamless cylindrical headers and tubes. All steam-carrying passages of heater condenser are pure copper or copper alloy to eliminate electrolysis. *Modine Mfg Co, Racine, Wis.*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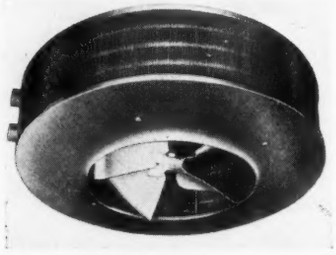
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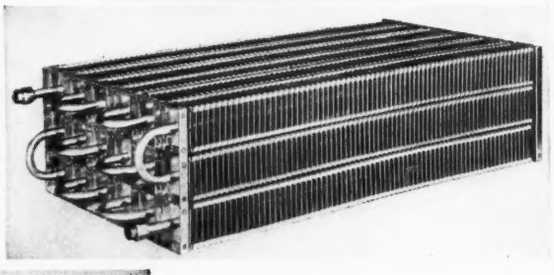
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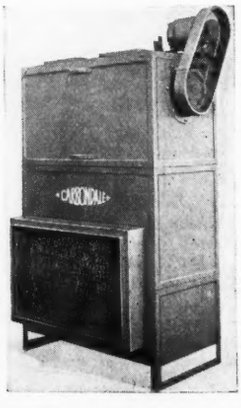

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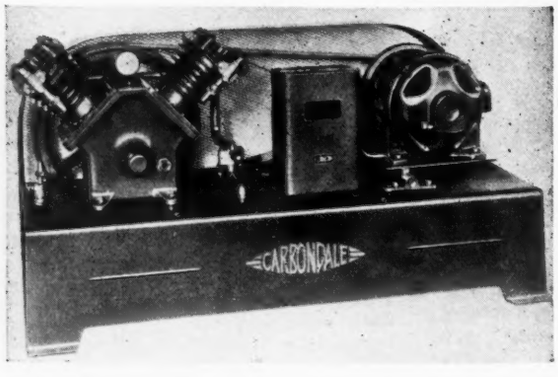

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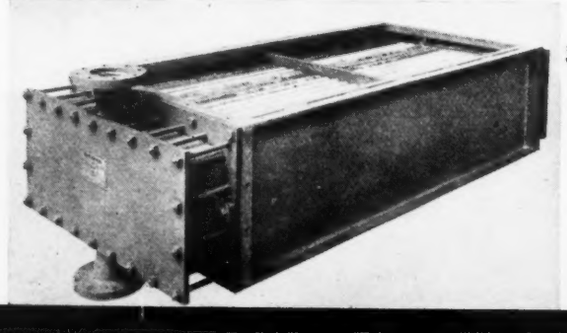
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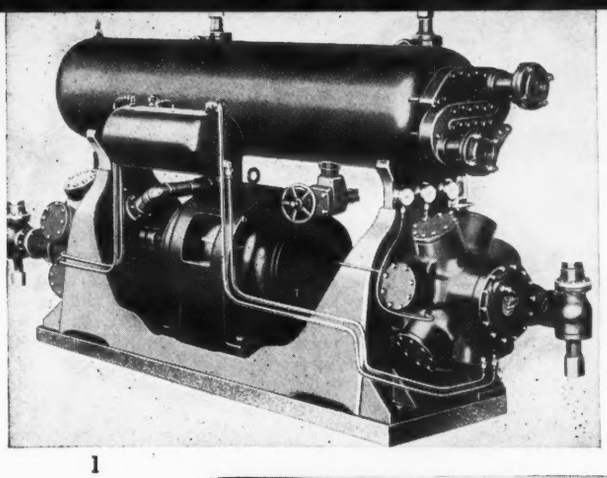

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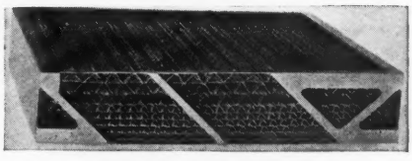

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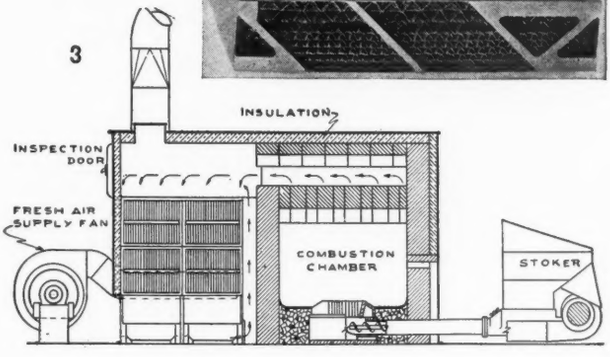

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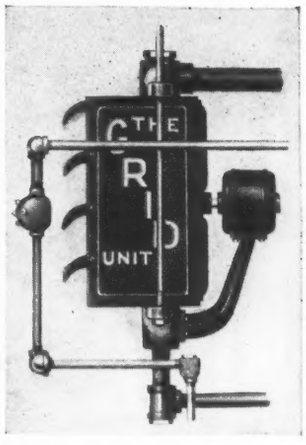

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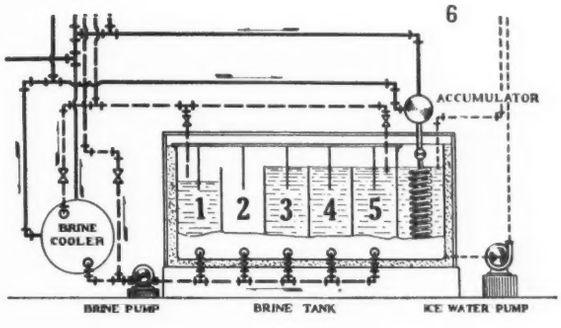

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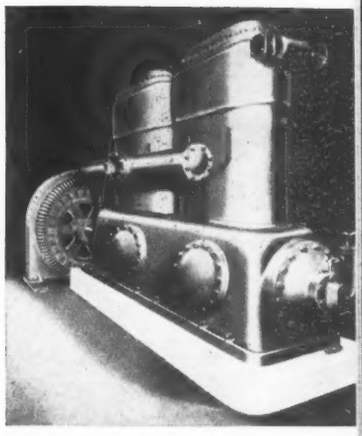

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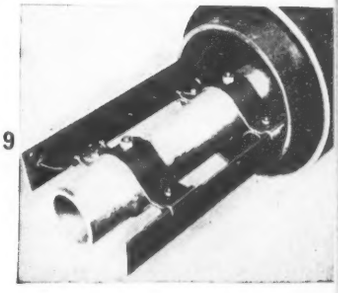

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1 RADIAL AIR - CONDITIONING COMPRESSOR — Seven compressing cylinders are arranged in a circle around crankshaft. Balanced construction; operating speeds up to 1750 rpm. Built in sizes of 100 to 75 hp. Large valve areas combined with small lift provide quiet operation. Auxiliary intake ports, opened by piston as it completes downward stroke, accelerate cylinder-air intake. *Airtemp, Inc, Detroit, Mich.*

2 AIR-FILTER PANEL—"Air-Maze" panels are alternately spaced flat and crimped galvanized wire screens enclosed in a 16-gage steel frame with open-end lubrication. Stock sizes are 2- and 4-in. thick in 10x20, 20x20 and 16x24 in. Recommended capacity is 2 to 2½ cfm per sq in. *Air-Maze Corp, 812 Huron Rd, Cleveland, Ohio.*

3 AUTOMATIC AIR HEATER—For industrial use, Smith automatic coal-fired air heater is essentially a combustion chamber to which coal is fed automatically by stoker under automatic control. One motor, thermostatically controlled, drives both fan and underfeed worm stoker. Air passes into combustion chamber and mixes with any unconsumed gas, which is burned before passing through heavy perforated arch. Will heat air up to 700 F. *James Campbell Smith Inc, 16374 Euclid Ave, Cleveland, Ohio.*

4 UNIT HEATER AND COOLER—Directional rotating louvre can be set at any angle. 2-speed motor gives either high or medium air delivery. All-copper core for heat-transfer surface has heavy seamless copper tubes and copper fins bonded together. Model *A* unit has 12-in. fan, maximum air delivery of 334 cfm, heat output of 36,000 Btu per hr. Model *AA* has 16-in. fan, maximum air delivery of 610 cfm, heat output of 54,200 Btu per hr. *Hexcel Radiator Co, Racine, Wis.*

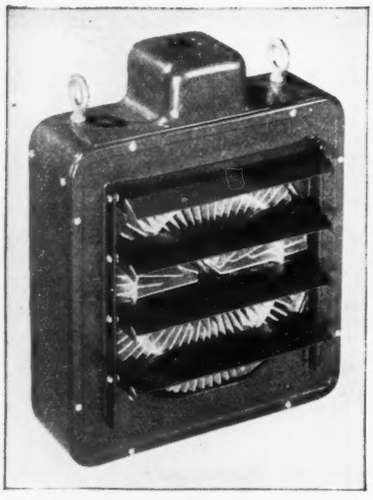
5 HUMIDIFIER—"Grid" humidifier may be attached either in front or back of unit heater, or as an individual unit. Operation of humidifier is at temperatures higher than room, which causes quick absorption of humidifying fluid or gas. For manufacturing plants that require variation in humidity conditions due to special processes or conditions. *Unit Heater & Cooler Co, Wausau, Wis.*

6 BRINE TANK—Multi-compartment tank prevents cold brine from being affected by warmer return brine. With compartments Nos. 1, 2, 3 and 4 full, consumption begins at No. 4, No. 5 being empty. Brine pumped from No. 4 returns to No. 5, and as No. 4 is empty, brine is taken from No. 3, warm brine still returning to No. 5, which fills up and overflows into No. 4. This uses only lowest temperature brine for cooling without increase in initial temperature at any time. *Carbondale Div, Worthington Pump & Machinery Corp, Harrison, N. J.*

7 AIR FILTER—Impingement-type filter has four successive stages of filtration, in form of two endless curtains, arranged to rotate so that curtain face, on dirty-air side, will be cleaned before returning to clear-air side. First stage collects heavier parts of dust and breaks up air stream, thus causing it to assume more intimate contact with adhesive surface. *Staynew Filter Corp, Rochester, N. Y.*

8 AMMONIA COMPRESSOR — High-speed, multiple-cylinder ammonia compressor follows general construction of York vertical single-acting compressors. Light-weight valves, pressure lubrication throughout and high rotative speeds. Built in sizes to furnish from 100 to 800 tons of refrigeration. *York Ice Machinery Corp, York, Pa.*

9 OIL CHILLER—Shell-and-tube unit; for multiple-stage cooling of cold-test oils, rapid refrigeration, etc., has 1170 sq ft effective chilling surface. One packing gland to 146 sq ft of chilling surface and special design which prevents loss of solvent. Specially designed scrapers keep tube surfaces free of wax. *York Ice Machinery Corp, York, Pa.*



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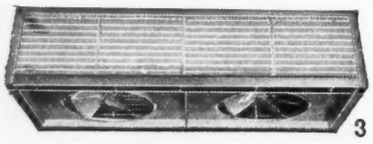

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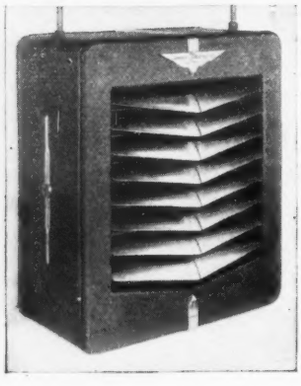

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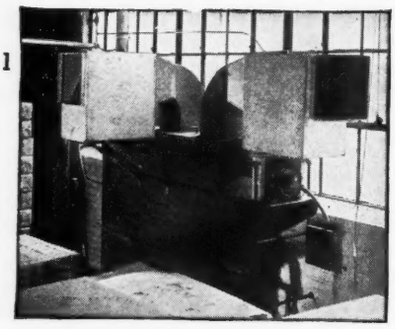

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1 HUMIDIFIER—Humidity box is essentially a spray chamber with water filter and nozzle, air filter-eliminator or baffle, and drain fitting. Where less than 30-lb-per-sq-in. water pressure is available, an electric vaporizer may be used to secure atomization. Although illustration shows two humidifier units on warm-air outlets of blower-type unit heater, humidifier can be used with propeller-fan unit heaters, or with any warm-air current, whether in free air or duct. Supplied with or without fans or blower units. *Air Conditioning Supply Co, 1893 E 55th St, Cleveland, Ohio.*

2 FAN-TYPE HEATER—Motor driven, 4-bladed aluminum fan, running on graphite-impregnated bronze bushing, dissipates heat from surface of circular grid and circulates warm air. Heat can be directed wherever needed by moving adjustable reflectors. Heat source is cast aluminum grid, poured around a Calrod heating element. *American Foundry Equipt Co, 555 S Byrkit St, Mishawaka, Ind.*

3 UNIT HEATER — "Multiple Projection" heater for ceiling mounting has two extended surface coils contained within metal casing. Motors are mounted out of air path; new 4-blade fan is used. Two, three or more fans. This unit is an extension of recently announced single-fan heater. *Trane Co, LaCrosse, Wis.*

4 UNIT HEATER—"Thermolier DeLuxe" unit is an industrial heater in a modern housing finished in crackle black and satin chrome. Heat distribution has been improved by new angular louvres which provide wide-spread heat flow. Inlet and outlet pipes have been relocated at rear, and specially-designed motor and fan are concealed. *Grinnell Co, Inc, Providence, R. I.*

HEATING-SYSTEM CONTROL—"Radisotat" consists of power transformer, secondary windings of which supply potentials to a full-wave rectifier tube and thyratron tube. Rectified dc operates through a Wheatstone-bridge circuit to control thyratron tube with associated relay which controls stoker motor. Resistance coils are mounted on outside of building, in boiler water, in return line from radiators and form parts of circuit. Unit operates stoker intermittently, furnishing just enough steam to balance heat input to radiators with heat loss to outside atmosphere. *Gaylord Mfg Co, 1227 Washington Blvd, Chicago, Ill.*

BACTERIA CONTROL—"Oakite Airefiner," when added to air-conditioning recirculating water used to wash or scrub air, is claimed to keep waste water sterile and prevent growth of slime and algae. Completely soluble, transmits no odor, and provides a stable, colorless solution that is safe and nontoxic. *Oakite Products, Inc, 22 Thames St, New York, N. Y.*

UNIT HEATER—Addition to line has capacities from 198,000 to 383,000 Btu at 60 F entering-air temperature, with steam pressures from 2 to 150 lb. Air volume is 3200 cfm. All cast-aluminum fin heating section in one part and bonded to high-test alloy-iron steam chamber. For industrial applications. *Unit Heater & Cooler Co, Wausau, Wis.*

HOSE, PACKING AND PAINTS

DUST AND BLOWER HOSE—For protection against lung disease of silicosis. Carcass of hose supported by steel-wire helix and finished with outside corrugations to lend flexibility. Made in three thicknesses of pure gum tube; size range 2 to 12 in. *U S Rubber Products, Inc, 1790 Broadway, New York, N. Y.*

WET-SURFACE PAINT — "Wet-X-Hale," when mixed with paint and varnishes, can be applied directly on to damp, moist and wet-from-rain surfaces. In spite of moisture deposit on surfaces and moisture in air, reaction of this compound said to deposit paint firmly on surface because it absorbs water, then separates from paint and forces itself with absorbed water through paint to top of film, where it decomposes and evaporates. *Wet-X-Hale Paint Compound Co, 572 Greenwich St, New York.*

STEAM HOSE—A steam- and heat-resisting rubber tube wound with 4 plies of high-strength asbestos cord alternating in direction; cords rubber cushioned and rubber wrapped. ½-, ¾-, 1-, 1¼- and 1½-in. ID sizes for 175 to 200 lb pressure. Maximum length 50 ft. *U S Rubber Products, Inc, 1790 Broadway, New York, N. Y.*

INSULATION—"Mikolite," cork-like mineral insulation, made from micacious ore heated under 2000 F for 16 sec and expanded to approximately 20 times original size. Weight changes from 80 to 7-12 lb per cu ft and substance becomes porous. Highly insulative, fire proof, moisture proof and impervious to decay. Capable of withstanding mixing with binders such as cement, mortar, etc. *Mikolite Co, 1317 Union Ave, Kansas City, Mo.*

HEAT-INDICATING PAINT—Changes color on exposure to heat. A series of 5 permanent-changes (ranging from 300 to 734 F) and seven retroactive (from 122 to 464 F) color paints are available, with safety margin of 25 F. Permanent-change paints require recoating after each change, retroactive paints are good for 25 to 50 changes. Either exterior or interior; will last at least 1 year. *Efkalin Co, Greenwich St, New York, N. Y.*

STEAM HOSE—Tube *A* and insulating layers *C* and *E* of special heat-resisting rubber compound; reinforcement of high-tensile steel wire *B* and *D* which cannot burn out or deteriorate. Wire is applied in braided form with opening large enough to permit rubber to rivet itself. Outside of wire braid and underneath cover is embedded additional braid of asbestos cord *F* to protect cover from burning. Heavy, long-wearing black rubber cover *G* compounded

with special anti-oxidant ("Agerite"). Sizes ⅜ to 2½ in. *B F Goodrich Co, Akron, Ohio.*

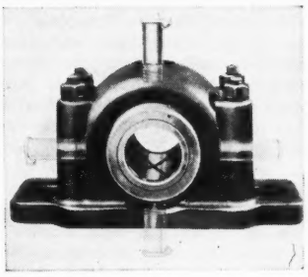
ASBESTOS PACKING—"Prenite 20M", a sulphur-free, "Neoprene"-bonded, compressed asbestos sheet offers high resistance to oil and refrigerants such as Freon, methychloride and sulphur dioxide. Made in 50x50-in. sheets of 11/32-, 1/64- and 1/16-in. thickness. *B F Goodrich Co, Akron, Ohio.*

WATERPROOFING — "Super-Por-Seal" applied to clean, dry concrete, stucco or masonry surfaces as a check against staining and efflorescence of buildings. May be applied with brush or spray apparatus. Covering capacity of 150 to 200 sq ft, one coat; or 80 to 100 sq ft, two coats. *Truscon Laboratories, Detroit, Mich.*

STEAM HOSE—"Great Seal Asbestos Cord" hose a 4-ply asbestos cord wound spirally in alternating directions around a steam- and heat-resisting tube embedded in rubber. ½-, ¾-, 1, 1¼- and 1½-in. ID sizes for 175 to 200 lb pressure. Does not char under high temperatures. Maximum length 50 ft. *New York Belting & Packing Co, 1 Market St, Passaic, N. J.*

ELECTRICAL-RESISTANT ENAMEL — Black enamel dries to a rubber finish, is tough and has high electrical resistance. Applied by spraying for finishing electrical apparatus such as switchboards and instrument boards. *Maas & Waldstein Co, 420 Lexington Ave, New York.*

MECHANICAL TRANSMISSION AND MATERIALS HANDLING



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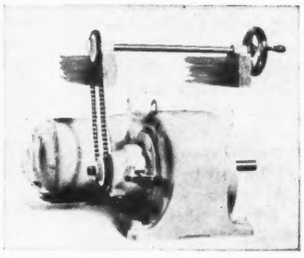

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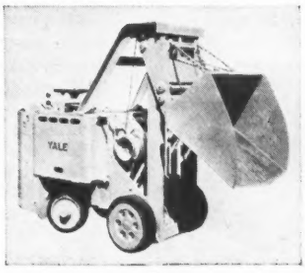

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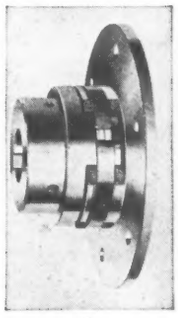

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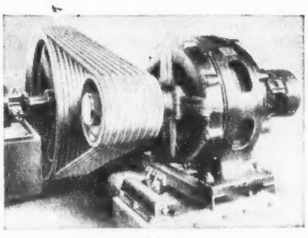

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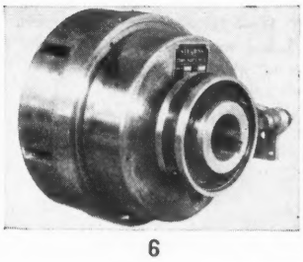

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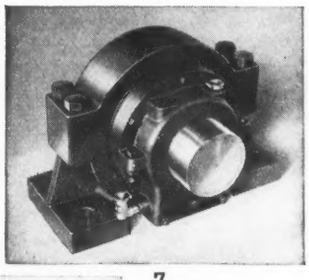

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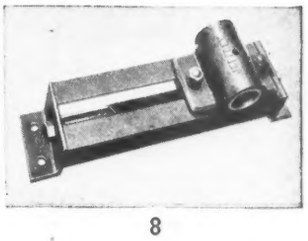

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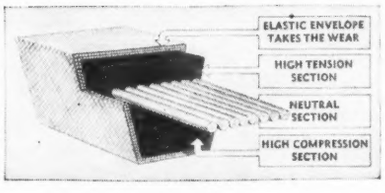

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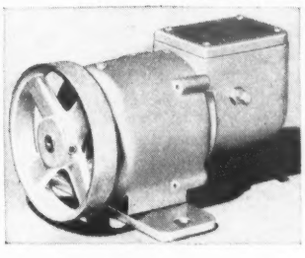

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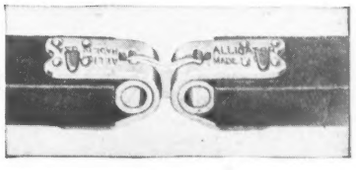

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1 PILLOW BLOCK—For mounting in any position, this pillow block has two oil reservoirs. Upper one feeds shaft as needed through graphite plugs and pressure-packed channels. Unconsumed oil is diverted through grooves into lower wool-packed reservoir, and is again fed to shaft and bearing through feed plugs. Claimed to operate for long periods on single oiling, and to have large bearing area. *Randall Graphite Products Corp, 609-613 W Lake St, Chicago, Ill.*

2 REMOTE MECHANICAL CONTROL — Positive remote control adapted to "U S Varidrive Motor". Bearing supports, shafting, sprockets and chains have been standardized. *U S Electrical Motors Inc, Los Angeles, Calif.*

3 DUMP TRUCK — Electric dumping-shovel scoop truck for handling in close quarters. Will pick up 10 to 15 cu ft in one load which can be elevated and dumped at considerable height. *Yale & Towne Mfg Co, 4530 Tacony St, Philadelphia, Pa.*

4 FLEXIBLE COUPLING — Compact unit made with one body in form of a flange which bolts to clutch, flywheel or brakedrum. Flange-body design reduces over-all length of standard L-R coupling by one-third. Sizes 3 to 14 in., bores for 2500 hp at 100 rpm. *Lovejoy Tool Works, 4976 W Lake St, Chicago, Ill.*

5 V-BELT DRIVES—Pivoted motor base said to improve V-belt performance by maintaining constant tension in belts. Tension removed from belts when motor is not running, permitting belt to "rest", gives longer life. Vertical, ceiling, and floor-mounting types. *Roockwood Mfg Co, 1801-2001 English Ave, Indianapolis, Ind.*

6 MAGNETIC CLUTCH—Cage floats around friction elements, thereby eliminating uneven wear. Latch-and-groove lock design provides quick adjustment. Either dry or wet application; automatic self alignment. *Stearns Magnetic Mfg Co, Milwaukee, Wis.*

7 PILLOW BLOCK—For service involving heavy end thrust. Entire radial load taken by roller bearing, while forces tending to displace shaft axially are borne by ball bearing. A spherical, 2-part, oil-tight housing provides self-alignment and is equipped with a levelling device for oil lubrication. Shaft sizes from $3\frac{7}{16}$ to 10 in., and radial load capacities up to 250 tons. *Fafnir Bearing Co, New Britain, Conn.*

8 SCREW TAKE-UP — For conveyors and elevators, this mechanism has adjusting screw protected from dust and dirt by inverted U-shaped shield. Sliding-base casting, carrying bronze adjusting nut, is cored out to slide freely over shield. Adjusting screw remains stationary inside steel frame. *Jeffrey Mfg Co, Columbus, Ohio.*

9 MULTI-V BELT—Close matching of multiple belts equalizes strain and load carrying. Load is carried by a layer of heavy low-stretch, high-tensile cord, placed on a neutral section between rubber high-tension and high-compression sections. Surface wear is taken by elastic-fabric envelope with weave on the bias. *Goodyear Tire & Rubber Co, Inc, Akron, Ohio.*

10 DRIVE PROTECTOR — "Saf-Driv" relay, for protection against motor-drive or belt failure is mounted so pulley is driven by belt or drive being protected. Pulley drives a shaft carrying centrifugal governor. In operaction, rotation force tips a mercury switch to close circuit. If drive fails or belt breaks, mercury switch tips back, breaks circuit, and sounds alarm or shuts down system, or both, as desired. *General Combustion Corp, Engineering Bldg, Chicago, Ill.*

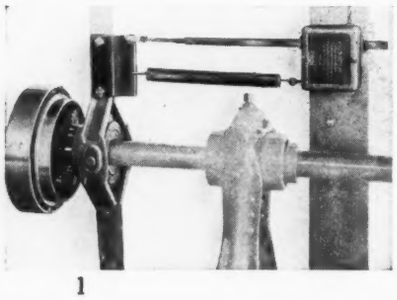
11 V-BELT FASTENER—"Alligator" V-belt fastener joins together C-section V-belts of fabric-core, cross-weave construction. Alloy-steel rocker pin supported in bronze bushings. Special method holds end plate to belt end without weakening belt or bulging its sides. *Flexible Steel Lacing Co, Chicago, Ill.*

PULLEY COVERING—Liquid covering, which gives a leathery adhesive surface to pulley, is applied in two coats. First coat dries in one hour, second in five hours. Manufacturer states that product provides clean and dry surface which will not attract dust or lint. One gallon covers 100 sq ft of pulley surface, two coats. *Warren Pulley Cover Co, Inc, 15 Union St, Lawrence, Mass.*

BELT HOOKS—"Wiregrip" hooks mounted on special cards, permitting workmen to cut off desired number without destroying others. Made of finest wire available and said to stand long continuous, hard usage. May be applied with any standard belt lacer. *Armstrong-Bray & Co, 308-310 N Sheldon St, Chicago, Ill.*

V-BELTS—Use of cords, soaked with liquid rubber, as tension members of V-belts said to increase belt life. Rubber-soaked cords cement themselves to surrounding rubber belt, minimizing loosening of tension members as belt flexes and bends around sheaves. Used in Gates "Vulco" belts. *Gates Rubber Co, Denver, Colo.*

1 REMOTE-CONTROL CLUTCH RELEASE —Elec ro-mechanical latch mechanism is connected to yoke of standard "Hilliard" friction clutch. Release box mounted at position shown or at some other location, providing that lever is three times as long as distance from fulcrum to shaft. May be operated with or without pushbuttons. Small current required as release opens its own circuit as soon as it operates, giving protection against arcing. *Hilliard Corp, Elmira, N. Y.*



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2 DIFFERENTIAL CONTROL—Three parallel shafts operating in oil bath within unit housing. Gears of 1:1 ratio drive between shaft 1 and differential gearing. Between shaft 3 and differential gearing is 1:1 chain drive. For automatic control service, shafts 1 and 3 are connected to driven machine or machines. Shaft 2 is connected to speed-changing screw of Reeves transmission. When shafts 1 and 3 are driven in same direction at same speed, shaft 2 stands still. When speed of driven machine varies above or below desired speed, variation is transmitted to shaft 2 which speeds up or slows down transmission until synchronous speed is restored. *Reeves Pulley Co, Columbus, Ind.*

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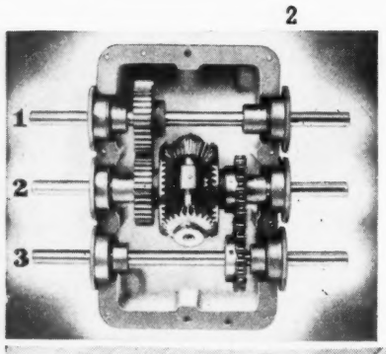
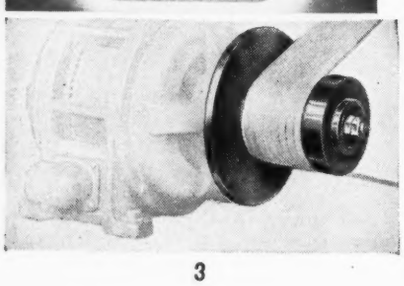


3 AUTOMATIC CLUTCH — Three principal parts: drive plate keyed to drive shaft; movable plate, upon hub of which is keyed a pulley, sheave or sprocket — entire assembly being mounted on a quill; and floating on a shaft, actuating unit equipped with time-lag adjusting mechanism and centrifugal weights which operate movable clutch plate as actuating unit comes up to speed. Size range of 1/20 to 350 hp, speed range of 600 to 3600 rpm. *Dickson Automatic Clutch Co, 606 S Hill St, Los Angeles, Calif.*



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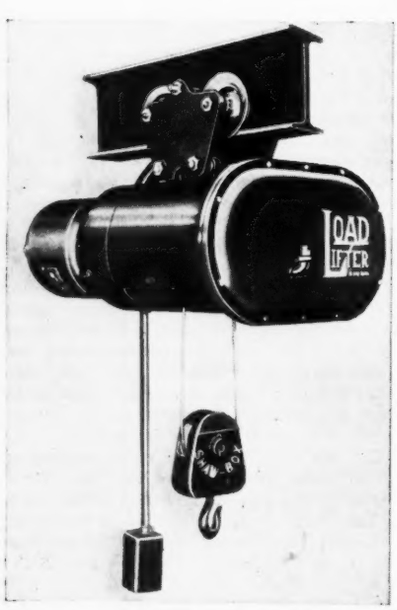
4 ELECTRIC HOIST—"Load Lifter Junior" built in sizes to lift 350 and 750 lbs. Lifting speed of 20 fpm with rated capacity loads. Push-button control unit suspended from hoists. Enclosed ball-bearing motor, electrical motor brake and automatic mechanical load brake. Gearing and mechanical load brake operate in oil bath. *Shaw-Box Crane and Hoist Co, Inc, Muskegon, Mich.*



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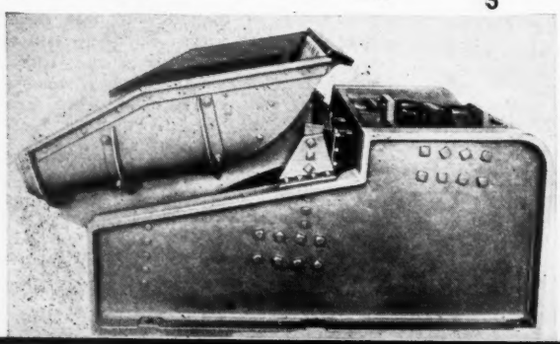
5 MATERIALS FEEDER—For coal, ore, rock, etc, electro-magnetic feeder uses ac. Power is received through wall-mounted rectifier, auto transformer and amplitude speed-adjusting switch. Straight-line reciprocating armature, mounted between two pole pieces, splits ac cycle, sending half of sine wave to each pole piece. Two types, suspended or rubber-mounted on foundation. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*



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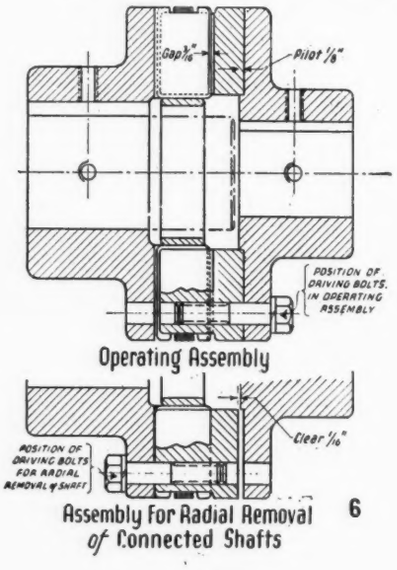
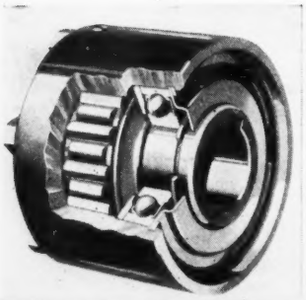
6 FLEXIBLE COUPLING—Type W flexible coupling has one set of jaws made in form of a removable ring which is held in place and driven by 3-, 5-, 7- or 9-hexagon head alloy-steel capscrews operating from jaw body. Cushions are free floating between metal jaws and retained in place by steel band. Bores of 1½ to 14 in. 2 to 2000 hp at 100 rpm. *Lovejoy Flexible Coupling Co, 4976 W Lake St, Chicago, Ill.*


Gap 3/16"
Pilot 1/8"
POSITION OF DRIVING BOLTS IN OPERATING ASSEMBLY
Operating Assembly
Clear 1/16"
POSITION OF DRIVING BOLTS FOR RADIAL REMOVAL of SHAFT
Assembly for Radial Removal of Connected Shafts

6

7 FREE-WHEELING CLUTCH — Multiple cams, spaced alternately with hardened ground-steel rollers, distribute load evenly on each cam. Cam action governed by two leaf springs that contact shouldered surfaces milled at each end of cams. Point of spring contact at center creates rocking action so that when speed of inner and outer races synchronize, cams immediately lock. A ball bearing at one end separates members and stabilizes load. Opposite end of unit is prepared for attachment of sprocket wheel, ratchet arm, or belt pulley. *Morse Chain Co, 7601 Central Ave, Detroit, Mich.*



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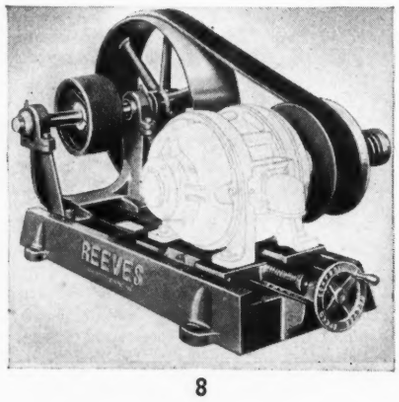
8 VARIABLE-SPEED MOTOR PULLEY — Unit is mounted on standard shaft extension of constant-speed motor. Through hand-wheel control, sliding base on which motor and unit are mounted is moved forward or back, varying diameter of a set of adjustable disks from which V-belt runs to driven machine. 7 sizes, from fractional to 7½ hp; speed ratios of 3 to 1. *Reeves Pulley Co, Columbus, Ind.*

9 FLEXIBLE COUPLING—"Rybeck" flexible coupling, full floating, semi-universal joint, transmits torsional load through groups of Swedish-steel laminated springs confined in a housing to eliminate all motion except deflection. Alloy-steel driving pins, heat treated, are pressed into steel hubs and fit into holes drilled into torque sleeves, held in alignment by housing. *T L Smith Co, 2813 N 32nd St, Milwaukee, Wis.*

10 VIBRATING SCREEN—Electro-magnetic motor, attached mechanically to screen, is powered through a rectifier and small auto transformer, permitting use of standard ac. Dual magnets apply force equally in both directions eliminating springs. Rectifier splits ac cycle into halves and delivers each successive half wave in turn to upper and lower magnets. Reciprocating motion is transmitted



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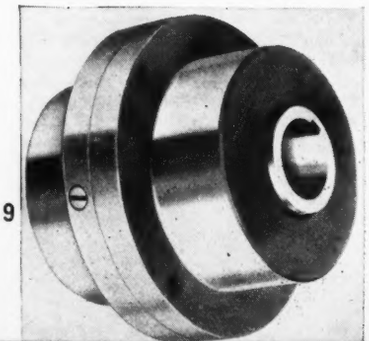

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to screen without any revolving parts. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

11 VARIABLE-SPEED CONTROL — Single shaft has two adjustable V-belt pulleys which vary in diameter as their distances from driving and driven pulleys are changed. Over 90% efficient, and offers infinite speed selectivity within ratios of 5 to 1. Size range of ¼ to 7½ hp. *Columbia Vari-Speed Co, Wheaton, Ill.*

12 PILLOW BLOCK—"Cushioned Bronzoil" bearing, developed for fan and blower service, has synthetic-rubber insulating band enclosing inner unit. Bronze bushing is oiled by capillary action from reservoir in cast-iron inner housing. Inner unit supported on split pressed-steel outer housing which is self-aligning. *Dodge Mfg Co, Mishawaka, Ind.*

13 SMALL HOIST—Will handle loads up to 500 lb. Although gearless, has lifting ratio of 15 to 1, obtained by winding cable on large drum as smaller drum unwinds. Motivated by sprocket and endless chain. Latch acts as ratchet while load is raised, and is disengaged in lowering, instantly engaging when released and stopping downward movement. Hoist travels on 1½-in. pipe or I-beam. *Newo Hoist Co, 17309 Fernway Rd, Cleveland.*

14 OIL-FILM BEARINGS—These bearings are interchangeable in size with existing types of ball and roller bearings made to international standard dimensions. Unlimited life as load is carried entirely on oil film. Hub journal is formed with lips on either side that collect oil flowing by gravity from housing and, due to journal hub rotation, oil is forced under centrifugal pressure out between various shoes or blocks. *Fast Bearing Co, Hampden Ave and 23rd St, Baltimore, Md.*

15 ELEVATOR BUCKET—"Super Salem" bucket reinforced at digging lip, front corners and along back. Made in 2½x2½- to 30x8-in. sizes, either steel, copper, brass, aluminum, Monel metal, or stainless steel. Additional strength and greater resistance to wear are claimed for this construction, without increase in weight. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

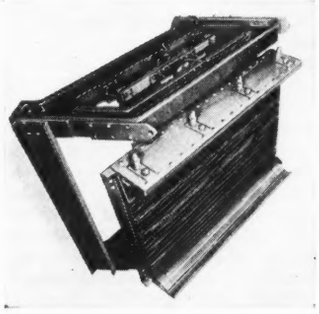
16 SELF-LUBRICATING BRONZE BEARINGS—Made of porous metal impregnated with oil (metal said to have average porosity of 32%, which is fully impregnated with oil). Bearings are high in strength and able to stand rough handling without distortion. *Keystone Carbon Co, St Marys, Pa.*

17 SPEED REDUCER—Addition to line of worm-gear speed reducers has center distance of 7¼ in. with ratios of 3⅞ to 1 up to 2450 to 1. Ratings range from ½ to 27½ hp in single-reduction output-torque ratings of 12,600 to 21,000 in. lb in double-reduction types. *Foote Bros Gear & Machine Corp, 5301 Southwestern Blvd, Chicago, Ill.*

18 SELF-GUIDING BELT CONVEYOR—Conveyor belt is molded with a continuous center-guide strip on underside. Antifriction idler with deep groove on central roller confines guide strip on both runs. Belt maintains central carrying position at all times, even when conveyor is tilted at a considerable degree. *Link-Belt Co, Chicago, Ill.*

19 BELT-CONVEYOR CARRIER — Lightweight, rigid-truss frame is supported on two parallel pipes. Carrier brackets are clamped to pipes without boring holes. By using standard piping, light sturdy conveyor frame can be quickly assembled from standard materials. Rocker mounting permits carrier to tilt in either direction with travel of belt. *Stephens-Adamson Mfg Co, Aurora, Ill.*

TESTING SIEVE SHAKER—For testing fine materials, "End-Shak" sieve shaker has simplified hold-down device which permits 1 to 13 sieves to be put in place and removed. Combined reciprocating and turning motion causes sample to spread uniformly over sieve surface. *Newark Wire Cloth Co, Newark, N. J.*



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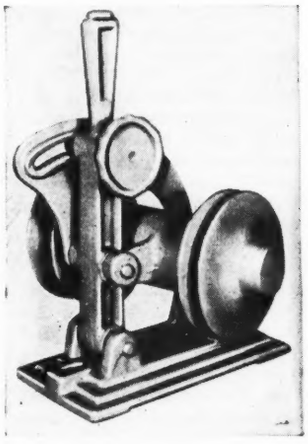

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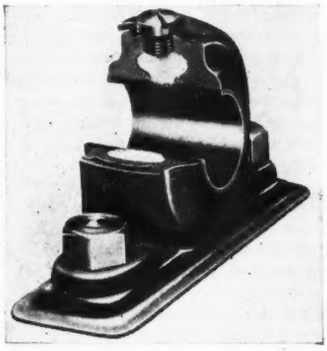

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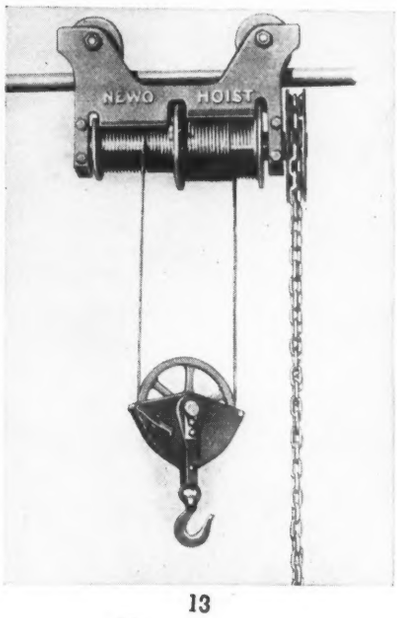

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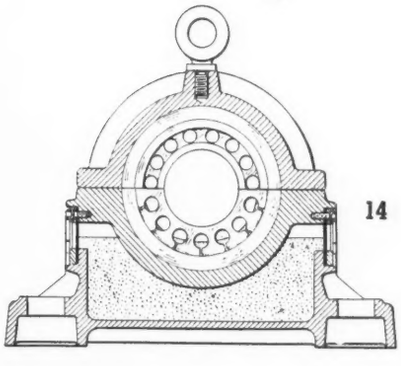

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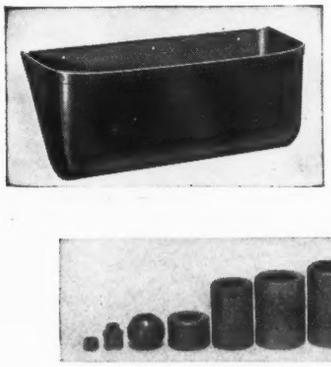

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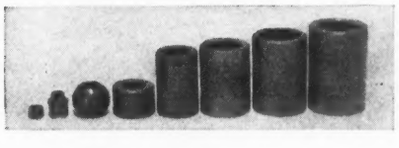

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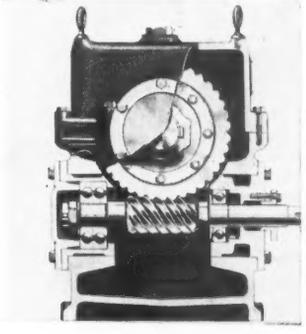

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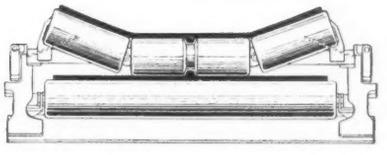

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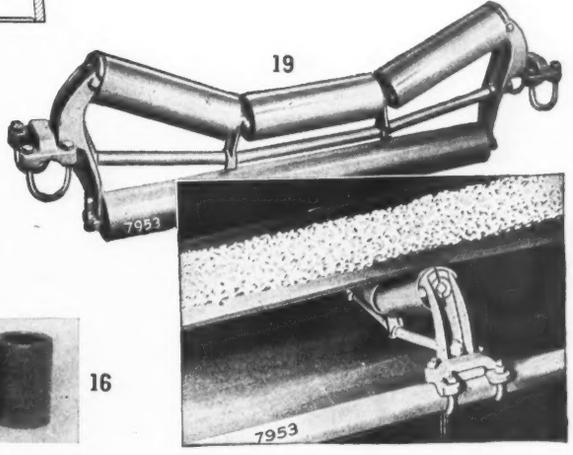

19

METERS AND INSTRUMENTS

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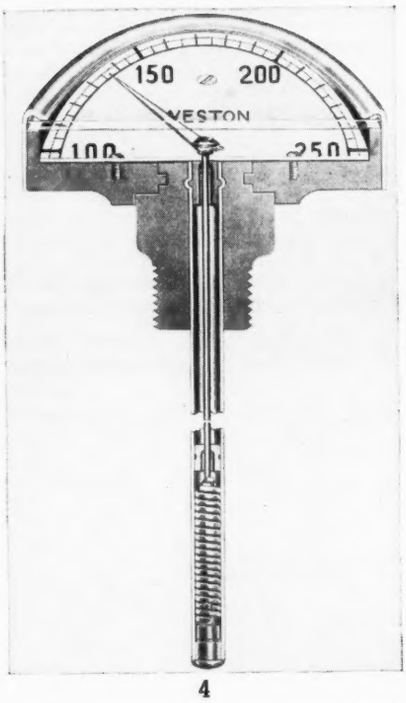

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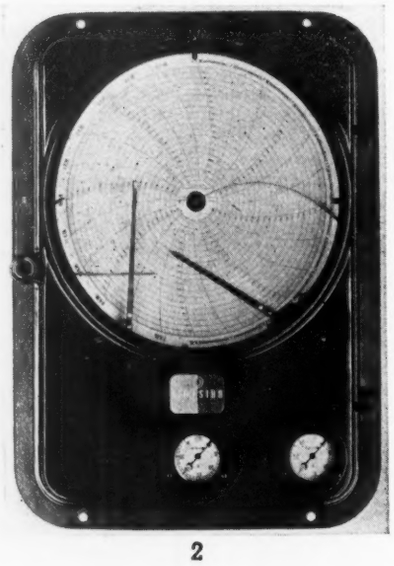

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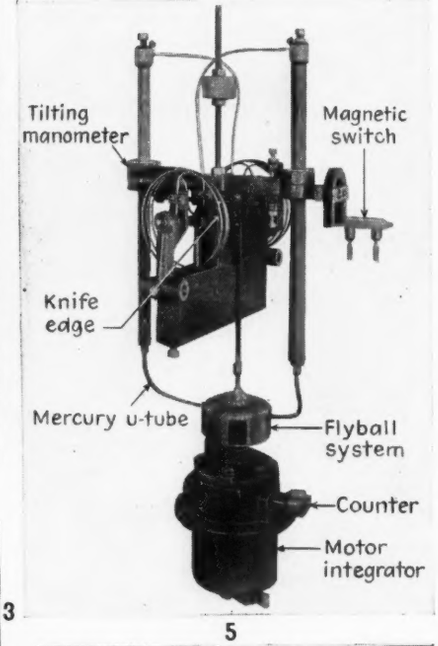

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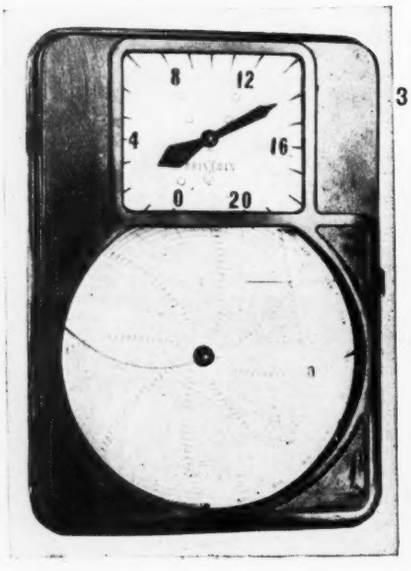

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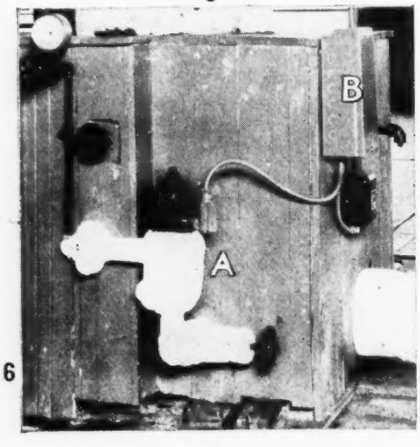


6

1 PORTABLE PYROMETER — Millivoltmeter portable indicating pyrometer measures temperatures up to 3000 F, using thermocouple and extension leads. Cobalt magnet permits increased sensitivity and widened scale for more accurate readings. High-resistance millivoltmeter movement is double pivoted and shielded to prevent effects of stray fields. Molded dust- and moisture-proof Bakelite case. *Bristol Co, Waterbury, Conn.*

2 PYROMETER CONTROLLER — Round-chart "Pyromaster" controller is a potentiometer-pyrometer, made either as a pneumatic or electric instrument. Automatically self-balancing and self-compensating for cold-end temperature changes. Pen arm actuated in small steps that follow each other at a rate depending on rate of change in thermocouple temperature. Not affected by plant vibration. *Bristol Co, Waterbury, Conn.*

3 POTENTIOMETER-PYROMETER — Much the same as instrument described immediately above. Operating mechanism consists of highly-dampened sensitive galvanometer, pivoted in jewel bearings; relay unit actuated by galvanometer to operate motor that balances electromotive force from thermocouple and positions pen arm and scale indicator. Provides for direct markings on 12-in. roundchart and scale indication on large dial. *Bristol Co, Waterbury, Conn.*

4 TEMPERATURE GAGES—Dial-and-pointer gages first industrial application of "coil within coil" design for bi-metal temperature-sensitive element. All-metal temperature element is sheathed within stainless-steel stem. Circular dial case, 3 in. in diameter, mounted at right angles to and at top of stem. *Weston Electrical Instrument Corp, Newark, N. J.*

5 INTEGRATING FLOWMETER — "Centrimax" flowmeter integrates directly by making use of centrifugal forces exerted by flyball governor. A tilting manometer, balanced against integrator centrifugal force, moves as manometer pressure varies and shifts mercury level in U tubes. At beam end, magnetic switch closes and opens to govern integrator rotation speed. Records up to 3000 lb per sq in. *Leeds & Northrup Co, 4902 Stenton Ave, Philadelphia, Pa.*

6 LIQUID-LEVEL CONTROL—Float chamber *A* consists of cast-iron chamber in which ball float rises and falls according to liquid-level changes. On top of float is a rod which moves in and out of tube fastened to top of float chamber. Tube and chamber are subjected to internal pressure as situation may call for. Around outside of tube at its top is coil whose leads run to control box *B*. Rod moving in and out of coil changes electrical characteristics, causing relays to function in control box, thus actuating connected equipment. *J G Russell Co, Inc, 103 Boston St, Boston, Mass.*

7 BOILER-WATER CONTROL—Combination high-pressure-pump control and low-water cutoff starts and stops boiler-feed pumps according to boiler-water level. Two controls have separate operating levels, and differential between two circuits is adjustable. Flexible metallic bellows transmits float power to outside switch mechanism. If pumps should stop and water level drop abnormally, cutoff stops stoker or oil burner and closes alarm circuit. For steam pressures up to 150 lb. *McDonnell & Miller, Wrigley Bldg, Chicago, Ill.*

8 THERMOMETER — "Mono-Therm" indicating and recording thermometer has thermal system which provides permanent seal for actuating medium. Entire system welded or braised to reduce possibility of leaky joints. Either vapor-pressure, gas-filled, or liquid-filled types. *Foxboro Co, Foxboro, Mass.*

9 FLOMETER INTEGRATOR—Electric integrator for flowmeter totalizes flow once every 15 sec. of a gas or non-viscous liquid through a closed line. A flat-disk cam, designed to coincide with flow law, mechanically computes square root of differential pressure across an orifice plate or venturi tube in a pipeline. Value obtained is totalized by a counter and indicated on a 6-figure dial. A continuous Telechron motor operates counter through a train of gears. *Bristol Co, Waterbury, Conn.*

10 ELECTRIC COUNTER—Either reset or non-reset, 5-digit counter has constant load on operating mechanism. Indicating wheels are geared together, eliminating tendency for counter to skip. Only one number appears on dial at a time. *Struthers Dunn, Inc, 139 N Juniper St, Philadelphia, Pa.*

11 VIBRATING-REED TACHOMETER — For measuring totational or rpm speeds of motors, turbines, spindles, shafting, and vibrations per min of pneumatic hammers and drills, "Frahm" tachometer records speed to 30,000 rpm. Illustrated is hand type which records when held against some stationary part of the machine. *James G Biddle Co, 1211-33 Arch St, Philadelphia, Pa.*

12 PYROMETER — "Bi-Optical" pyrometer based on use of light filters and color wedges which are transparent to a number of colors simultaneously. By using filters with a number of transparencies both for separation and toning down, complicated optical or mechanical devices are made unnecessary. Scale ranges of 900 to 1900 C or 1700 to 3500 F. *Pyrometer Instrument Co, 103-105 Lafayette St, New York, N. Y.*

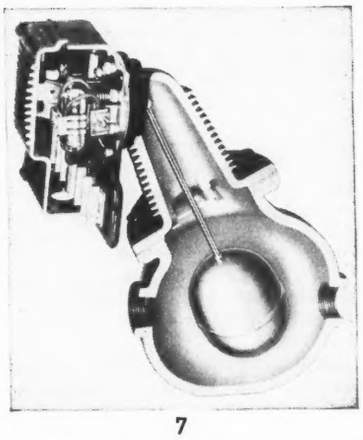
13 VIBRATION PICK-UP—Bimorph crystal, mounted inside of aluminum case, flexes of its own inertia and sets up voltage impulses of exactly same wave form as that of mechanical motion. Response is practically linear up to resonant frequency of 2500 cycles. Pick-up used with oscilloscope and output to determine frequency, amplitude, and velocity of vibration. *Sundt Engrg Co, 4238 Lincoln Ave., Chicago.*

14 PORTABLE BALANCING EQUIPMENT —For balancing large turbines, auxiliaries such as fans, exhausters, pumps and motors, this unit has two devices for measuring vibration. "Two-direction" vibrometer, at right, measures in two directions simultaneously and also indicates wave form. Single-direction meter is shown at center. Stroboscopic lamp with three neon tubes at left. *Electrocon Corp, 6 Varick St, New York, N. Y.*

15 AIR METER—For reading static pressures, velocities, cfm, drafts, etc, portable meter has gage, tubing, fittings, oil, data sheets in stiff carrying case, with pitot "static-head" tube. Transparent Bakelite gage does not leak while being carried, is easy to keep clean, and avoids errors due to parallax. Various types cover velocities from 400 to 8000 fpm or vacuums as low as 0.005 to 4 in. of water. *Julian P Friez & Sons, Inc, Baltimore, Md.*

16 TEMPERATURE CONTROLLER — "Tag" self-operating controller for industrial applications where close control obtained with auxiliary power is not necessary or where steam pressure is less than 10 lb. Temperature range of 75 deg between limits of 30 to 450 F. Semi-balanced valves, ½ to 2-in. sizes. *C J Tagliabue Mfg Co, Park & Nostrand Aves., Brooklyn, N. Y.*

17 ELECTRIC FLOWMETER — "Metameter" principal of telemetering transmits readings from point of measurement to a distant recorder over a 2-wire circuit, telephone circuits included. All electrical contacts glass-enclosed. *Bristol Co, Waterbury.*



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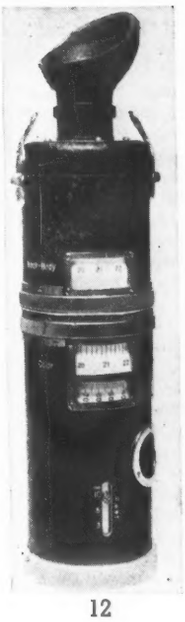

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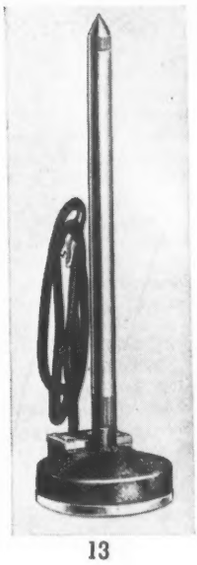

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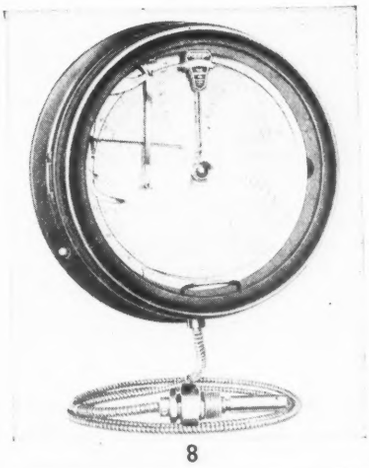

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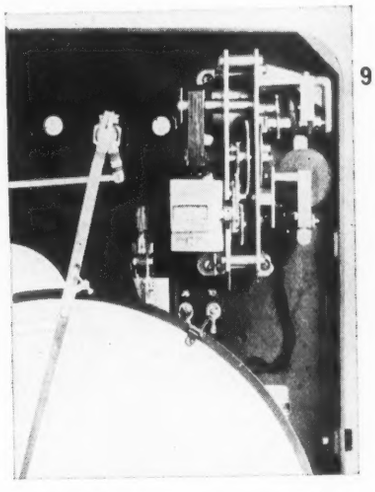

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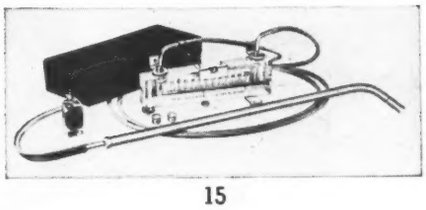

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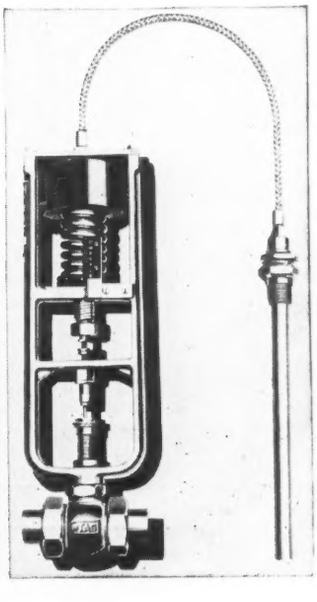

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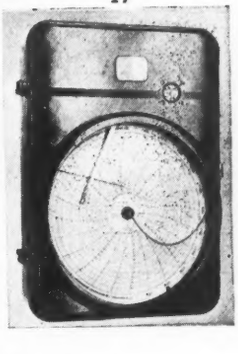


1 PYROMETER CONTROLLER — "Alnor" pyrometer controller, for automatically controlling temperatures, operates on electronic principle similar to radio circuit. When temperature pointer with its vane approaches temperature setting, vanes of pointer and target interleave and produce a circuit change which in turn operates a relay. Heating current if electric is shut off, or in case of fuel firing, fuel valve is closed partially or completely depending on type of valve used. Red bull's eye indicates whether heat in furnace is on or off. *Illinois Testing Labs, Inc, 420 N LaSalle St, Chicago, Ill.*

2 TEMPERATURE AND PRESSURE CONTROLLER—Compensator limits piston travel and prevents full stroke on each slight change of control pressure. One end of compensator has sliding contact with piston stem; other is attached to pilot valve and forms floating fulcrum. When control pressure drops, pilot-valve disk moves downward, operating pressure is admitted to cylinder, and stem moves upward causing floating fulcrum to move pilot-valve disk upward to neutral position. May be adapted to temperature control. *Davis Regulator Co, 2541 Washtenaw Ave, Chicago, Ill.*

3 HEAT-OPERATED RELEASING LINK—"Quartzoid" link is sensitive, immune to corrosion, and shatters at its rated temperature. Ability to carry loads up to 150 lb eliminates necessity of ganging several solder links. *Grinnell Co, Inc, Providence, R. I.*

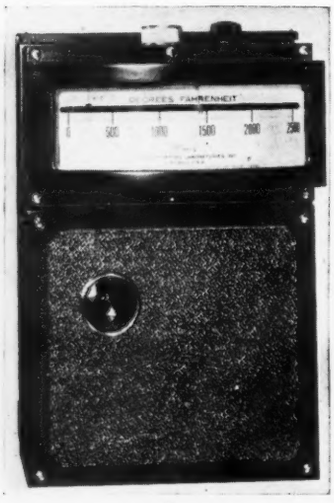
4 TIME-CYCLE CONTROLLERS — Two models have Bakelite cams, terminal panels for motor and circuit connections, and 15-amp "Staley" mercury switches, which on 110-volt non-inductive load circuit have capacity of 1650 watts. Model 611 operates 1 or 2 circuits at 15, 30, 45 or 60 makes and breaks per min. Model 602 for more complex speeds. *Electric Switch Corp, Columbus, Ind.*

5 TEMPERATURE RECORDER—"Electronic Instagraph", a 3-part unit: thermo-photronic tube, potentiometer amplifier and recorder. Photronic cell, responsive to thermal spectrum of a heated mass, reacts to spectrum by generating small electromotive force, which is measured, amplified, and recorded in terms of temperature. Illustration shows tube at center, amplifier at left, and recorder at right. Recorder uses strip-type chart with range of 0 to 2250 F. Appoximate total weight 80 lb. *Bristol Co, Waterbury, Conn.*

6 WATER-LEVEL RECORDER—Two models, FW-1 and FW-2, first a curvilinear coordinate and second a rectilinear coordinate type. Both identical in construction except for pantograph mechanism of Model FW-1 which provides vertical pen movement. Pantograph, by introduction of added parts, increases float-wheel torque to slightly less than ½ in. oz, making it more sensitive and accurate. Either 6- or 3-in. diameter float, temperature-compensated clock movement. *Julien P Friez & Sons, Inc, Baltimore, Md.*

7 POTENTIOMETER CONTROLLER—"Fulscope Micromax" air-operated potentiometer controller has same adjustable control mechanism used in "Fulscope" temperature, pressure, rate-of-flow, and liquid-level controllers. Temperature-measuring system gives automatic reference-junction compensation, positive balancing of potentiometer circuit, and current standardization. Fulscope control unit operates in conjunction with Taylor "Motosteel" diaphragm valve. Where precision valve action, or both precision valve action and compensation for load changes, may be necessary to prevent deviation from control point, Fulscope can be supplemented with "Valve-Precisor" or "Dubl-Response" control unit, respectively. *Taylor Instrument Cos, Rochester, N. Y.*

8 FLOWMETER — "Rotameter" has interchangeable precision-bore metering tubes which are as large as pipeline carrying flow. With these interchangeable tubes, any number of rotameters can be made duplicates of each other and spare tubes supplied of same calibration as original tube. Capacity scales are etched into glass and colored pigment is fused into graduations and numerals. Rotation of float throws off foreign matter and makes meter self cleaning. Range of models from high vacuum to 1500 lb per sq in. and to meters with tube over 20 in. long capable of measuring flow ranges of as much as 200 to 1. Recorders, integrators and automatic controller can be supplied; also made for automatic flow-control attachment. *Fischer & Porter Co, 110 W Penn St, Philadelphia, Pa.*



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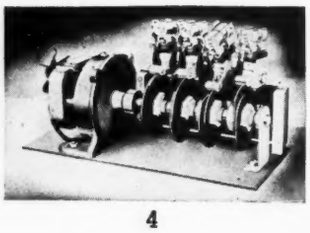
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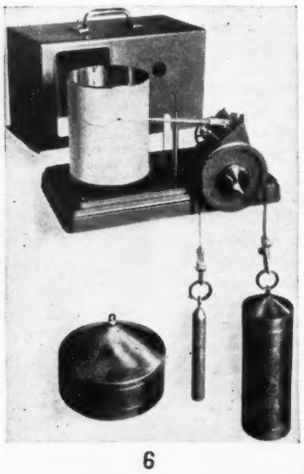
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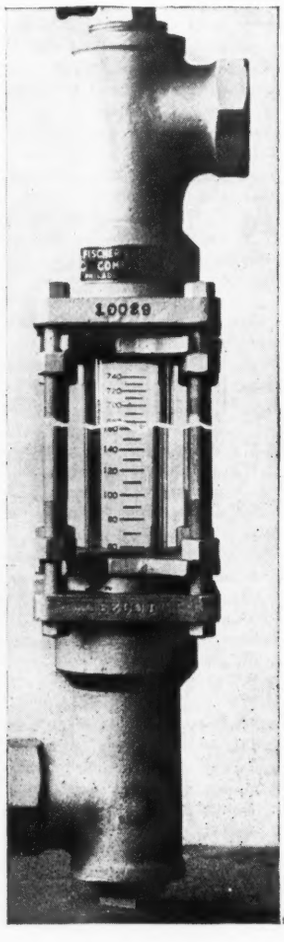

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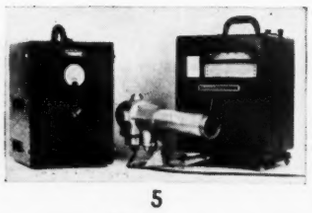
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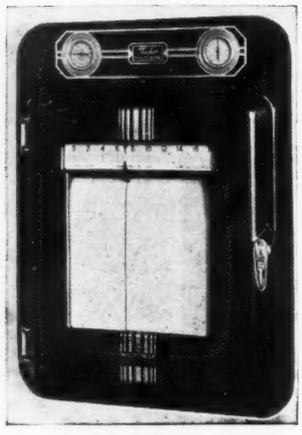
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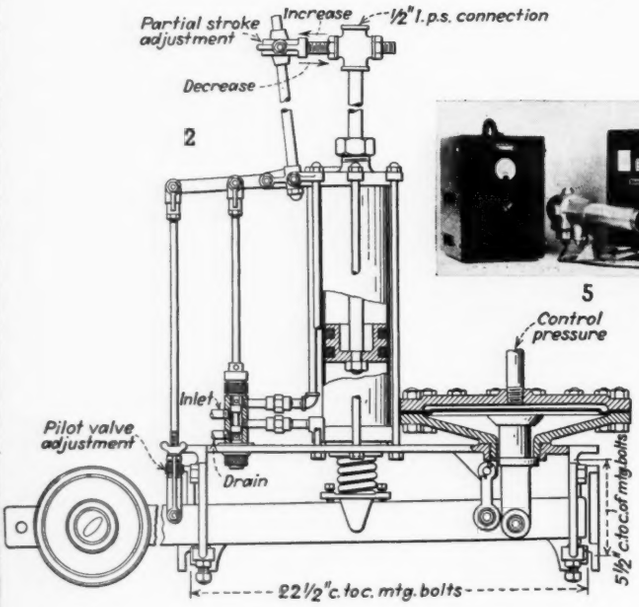

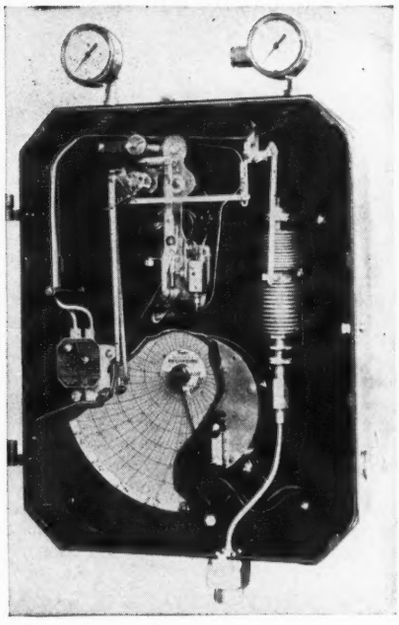

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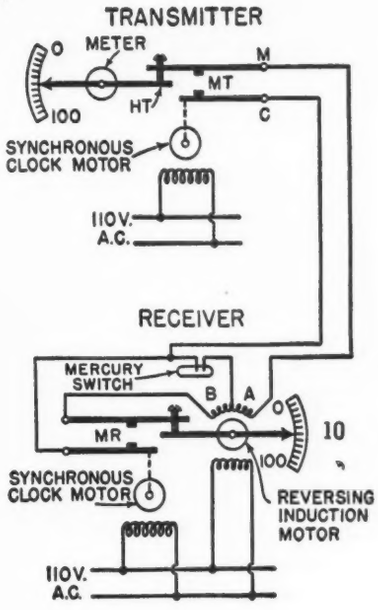

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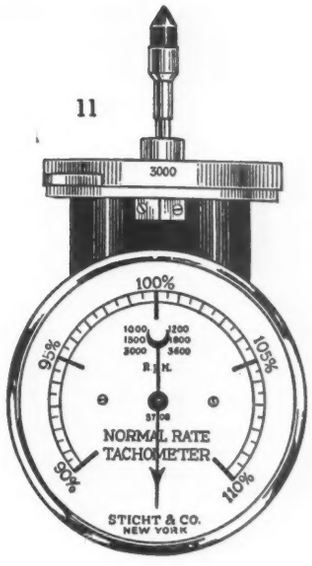

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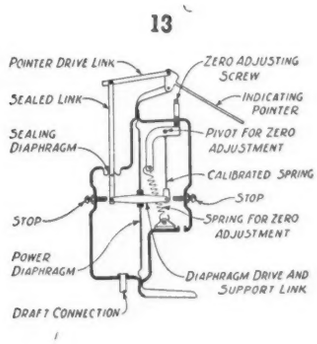

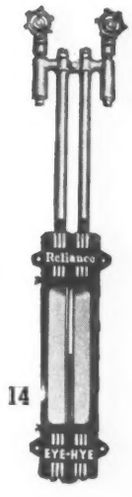

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9 ABSOLUTE-PRESSURE INSTRUMENTS—For low-pressure measurement, line of instruments for recording, indicating and controlling absolute pressure has flexible phosphor-bronze bellows to inside of which pressure medium under measurement is communicated. Connected with this assembly, and opposing its action, is a second identical metal bellows which has been evacuated and sealed, thus comprising an atmospheric-pressure compensator. Applicable to distillation units, evaporators, condensers, vacuum-return lines, turbine-exhaust pressures. *Taylor Instrument Cos, Rochester, N. Y.*

10 ELECTRIC FLOWMETER — "Synchro Meter" consists of a Ledoux bell-flow measuring mechanism and receiver containing indicating, recording and/or integrating instruments. Transmitter is located at point of measurement of variable and receiver at most convenient place. In diagram, contact arms of transmitter swing about points *M* and *C* and constant-speed cam swings lower contact arm in a continuous reciprocating cycle. Upper arm is positioned through stop *HT*. Receiver operates in a similar manner, except that upper contact arm is positioned by reversing induction motor. For 95 to 125 volts ac, 25, 50 or 60 cycles. *Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio.*

11 TACHOMETER—Two models: No. 500 for 25- and 50-cycle ac, range of 750 to 600 rpm; No. 501 for 50- and 60-cycle ac, range of 1000 to 3600 rpm. Dial graduation is in percentage, normal speed indicated by 100%. Set to desired speed by rotating cover until appropriate figure comes in line with index. *Herman H Sticht & Co, 27 Park Pl, New York, N. Y.*

12 THERMOMETER-THERMOSTAT CONTROL—Combines dial thermometer with automatic thermostatic control. Line voltage micro-snap switches are used in thermostats and as limit switches in valves, making relays unnecessary on ac for all loads up to 110 watts or ½-hp motor. Operates on a temperature range of —40 to 650 F. Two types: LS1, with single-pole switch and plain bulb of bronze or steel; and LS1, with two independent single-pole switches with adjustable differential between "high" and "low" switch. *Sarco Co, Inc, 183 Madison Ave, New York, N. Y.*

13 MULTI-POINTER DRAFT GAGE—This gage is a mechanical diaphragm-operated unit consisting of a flat calibrated spring, a sealed link, and a power diaphragm supported by a second link pivoted at one end on a calibrated spring, at the other on sealed link. Draft applied to left side of diaphragm causes movement of system to left which is opposed by flat calibrated spring. Motion is transmitted by sealed link and carried by drive link to indicating pointer. For pressure indication, connection is made to right side of diaphragm; for differential pressure, connections are made to both sides of diaphragm. Units of 1 to 12 diaphragms; semi-flush, or full-flush-mounted surface. *Bailey Meter Co, 1036 Ivanhoe, Rd, Cleveland, Ohio.*

14 DISTANT-READING WATER GAGE—"Eye-Hye" gage may be located on instrument board or other convenient place, and connected to actual water gage on water column or boiler drum by means of copper tubing which may be bent around obstructions as desired. Water level is shown on "Eye-Hye" gage by bright green liquid. Made for pressures up to 250 lb. *Reliance Gauge Column Co, 5902 Carnegie Ave, Cleveland, Ohio.*

TIME RECORDER—"Chronolog" an instrument which provides printed record of productive and down time on any machine or operation, and may also show causes and extent of idle time and a count of units produced. *National Acme Co, 158 East 131st St, Cleveland, Ohio.*

MODIFIED SCHERING BRIDGE—For determining characteristics of liquid and solid dielectrics, modified Schering bridge applies high voltage only to test sample and to standard air capacitor. All adjustable elements are confined within grounded shield. Bridge intended for 60-cycle currents and air capacitor and sample holder rated 10 kv. Apparatus for other voltages and frequencies can be supplied. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

PERMANENT METER CHARTS AND INK—"Permochart" lasts 3 years under normal operating conditions. Pen recordings removed from smooth, hard surface with damp cloth. Non-inflammable and waterproof. Made to fit any meters. Also recording ink, in purple, red or green. Will start flowing instantly and easily without flooding, does not cake on pens, and dries quickly without smudging or spreading. *Permochart Co, Pittsburgh, Pa.*

SMALL THERMOSTAT—Low-cost "Microstat" temperature control for heating or cooling equipment with very small control differential (wider if desired, easily adjustable). For low voltages (25 volts) yet able to carry electrical load of 75 watts directly off contact without relays. Incorporate "Alnico" sintered magnet with pure-silver snap-acting contacts, heat-treated and seasoned bi-metallic elements. Pressed-metal case, ivory or silver finish and plastic base. Attractive design, 3½ x 1½ x 1½ in. Well-ventilated case to give great sensitivity and point control. Built-in thermometer. Bulletin No. TM. *Julien P. Friez & Sons, Inc, Baltimore, Md.*

MISCELLANEOUS

1 ELEVATOR GATE-CLOSING MECHANISM—"Torque" motor important part of this mechanism. Opening and closing lever attached to quadrant driven by motor which can be stalled on circuit at end of travel without taking more than approximately full-load current, and without over-heating. Motor is switched on by gate-control mechanism until gate reaches end of travel, then is stalled at full torque until next movement of car, which reverses motor to close gate. Motor said to be adaptable to other uses requiring on-and-off cycle. *Ohio Electric & Mfg Co, Cleveland, Ohio.*

2 FIRE-PROTECTION UNIT — Portable unit has four 20-lb CO_2 and four pure-water extinguishers plus auxiliary equipment of an axe, two crowbars, rubber and asbestos gloves, blanket, first-aid kit, recharges for extinguishers, and gas mask. Unit may be handled by one person and is small enough to fit into elevators. Extinguishers shown at center are of new design in which pure water is expelled by pressure from CO_2 cartridge; four other extinguishers use dry CO_2 as extinguishing medium. Standard or special units can be supplied. *Walter Kidde & Co, 140 Cedar St, New York, N. Y.*

3 SEALING GLAND—This gland, in use on new Cummins diesel, seals connection between fuel pump and governor. On one side of boot, gland is subjected to fuel oil and on other side to lubricating oil, temperature of which may vary from below zero to about 250 F. Boot permits longitudinal expansion and contraction, and at the same time seals connection at each end. Seal is made of "Neoprene," which resembles rubber in elasticity, strength, resilience and abrasion resistance, but resists better deterioration of oil, chemicals, heat, etc. *Rubber Chemicals Div, E I du Pont de Nemours & Co, Wilmington, Del.*

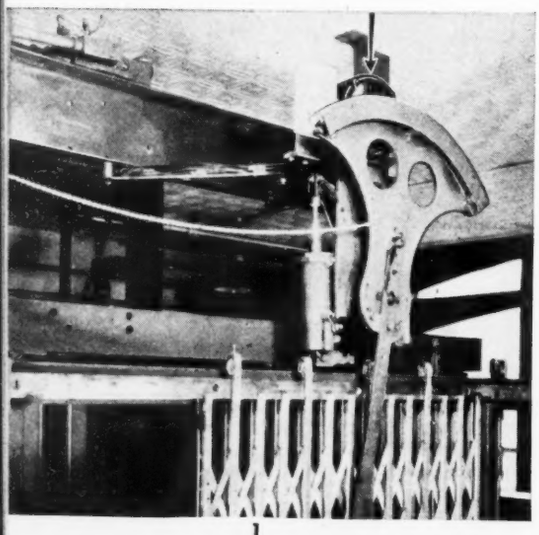
4 EMERGENCY SPRINKLER SHUT-OFF—"Tejax" sprinkler shut-offs made in two types, one for sprinkler head with crown up and one for head with crown down. Clasping hook has specially-designed horn curved to slip into sprinkler yoke. When the sprinkler is fitted to pole, it is operated through side lever. *Tefft-Jackson Inc, 2 Allen Ave., Providence, R. I.*

5 BURIED PIPE AND CABLE DETECTOR—Locates and measures depth of buried pipes, cable, and other metal objects. Consists of transmitting and receiving radio sets, either 1-man or 2-man units. To trace a line, operator, carrying receiver, follows path along which sustained signals are received. Almost all parts of "M-Scope" are standard radio equipment energized by dry cells. Individual units weigh about 8 lb each; complete instrument weighs approximately 22 lb. *Fisher Research Laboratories Sales Co, 45 Rockefeller Plaza, New York, N. Y.*

6 ELEVATOR ROLLER-GUIDE SHOES—Consist of rubber-tired wheels, supported by a spring action similar to "knee-action" of automobile, which roll silently on elevator guides. Manufacturer claims quietness and smoothness of operation and greater economy, as no lubrication is necessary. *Otis Elevator Co, 11th Ave. & 26th St, New York, N. Y.*

7 GAS INDICATORS—UCC gas indicators detect explosive or irrespirable gas-air mixtures. Model 12-B, for detection of combustible gas or vapor, has graduated meter scale which indicates by direct reading whether combustible gas is present and whether concentration is below, above or within explosive limits. Model B-1 (shown in illustration) combines three units in one to show presence of combustible gas, to indicate oxygen deficiency, and includes toxic chamber for determining CO and H_2S. Both have patented air-dilution valve by which incoming samples can be diluted with any volume of air, thus making it possible to detect flammable conditions which might not be indicated because of lack of oxygen in the atmosphere. *Linde Air Products Co, 205 E 42nd St, New York, N. Y.*

8 LIQUID-HANDLING UNIT — Direct-pressure "Liquivator" consists of stationary pressure tank to which an operating valve mechanism is externally connected. Counterweighted displacement tanks within pressure tank provide power for valve control through leverage. Since valve mechanism is separate from tank, it may be assembled with any size tank for handling any given volume of liquid. Made in both metering and non-metering types. Either type can be furnished in self-contained or remote-control assembly to meet individual requirements. *Morehead Mfg Co, Detroit, Mich.*



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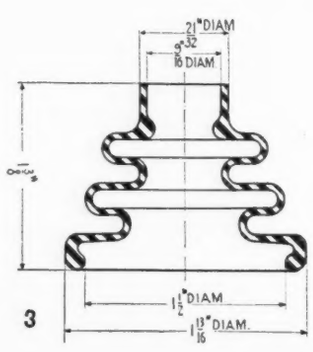

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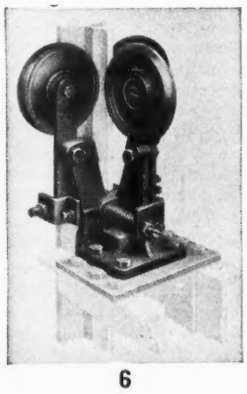

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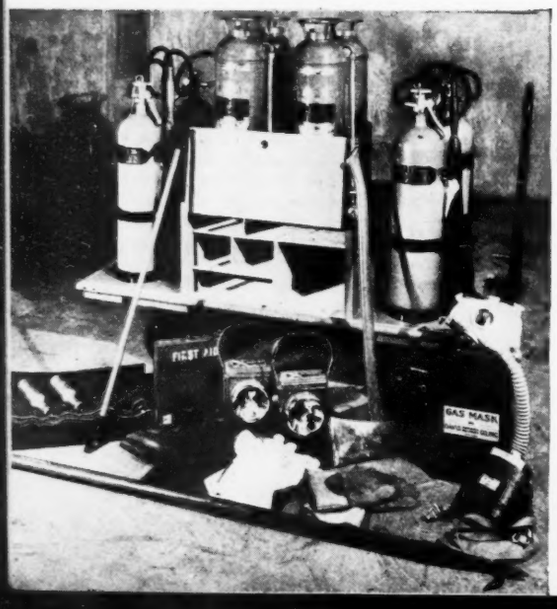

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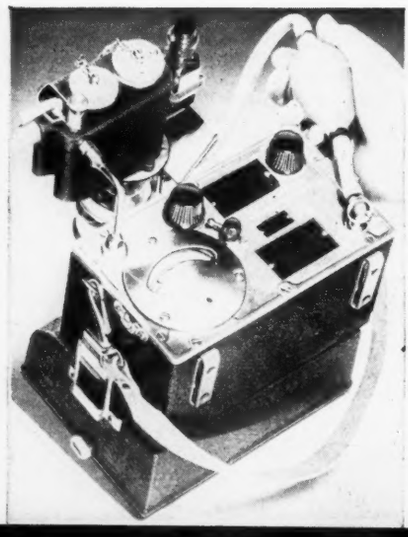

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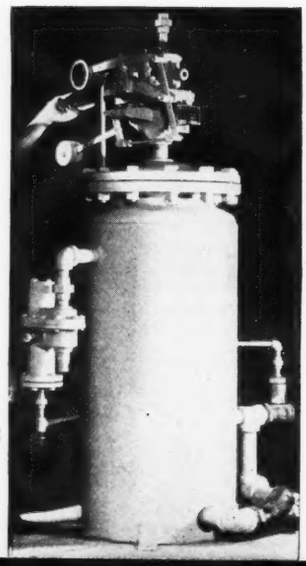

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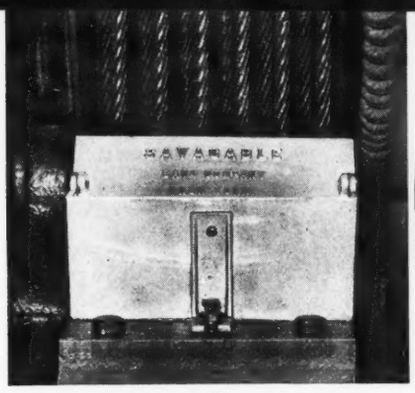

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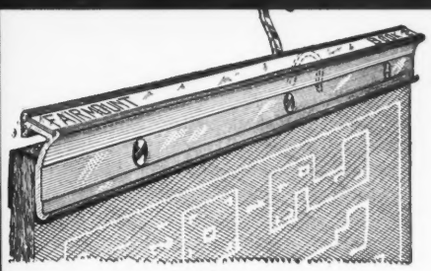

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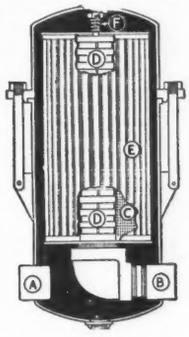

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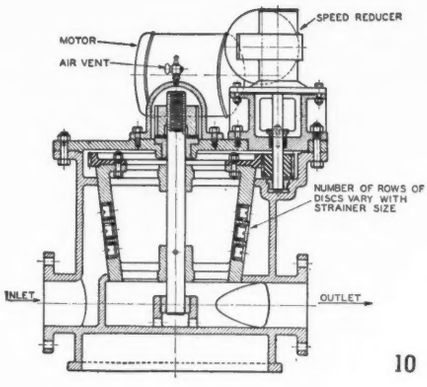

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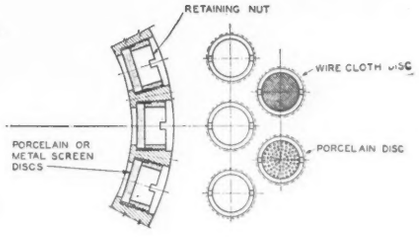


9 WIRE-ROPE LUBRICATOR—For elevator ropes, lubricator consists of tank extending across width of rope space, with flat wick extending from tank bottom and pressed tight between tank and ropes. Each rope cuts its own groove half its depth in wick within 1 or 2 hr, then siphon action supplies lubricant. A compression board of special rust- and corrosion-resisting material holds wick in place, and may be tightened down by adjustment nuts to retard oil flow. *Sava Co, 205 E 42nd St, New York, N. Y.*

10 AUTOMATIC STRAINER — Self-cleaning strainer consists of conical drum revolving in cast-iron housing. Side drum has 1⅜-in. holes with screening disks held in place by retaining rings. Screens may be brass, Monel metal, stainless-steel cloth or new type porcelain filter. Cylinder is revolved slowly by self-contained motor and on each revolution filter disks pass by washout connection where reverse flow automatically cleans filters. *H A Brassert & Co, 310 S Michigan Ave, Chicago, Ill.*

11 BLUEPRINT BINDER AND HANGER —Made of light duraluminum with steel center hook that can be turned back for reference. Three telescoping binder screws with metal strip at back hold prints. Holes for permanent, or slots for temporary, insertion may be cut with knife or shears. Renewable title strip may be lettered to suit. Stock sizes are 18, 24 and 30 in. *Wade Instrument Co, 2246 Brooklyn Station, Cleveland, Ohio.*

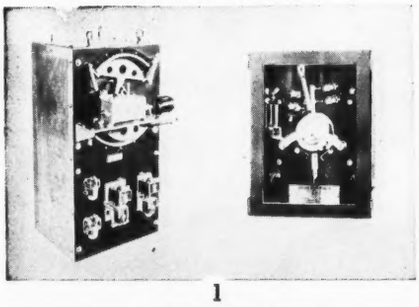
12 LUBRICATING-OIL FILTER — Model CPHL liquid-line filter made mainly for horizontal oil lines. Plug in bottom of filter shell can be removed for draining. May be opened quickly for inspection and cleaning. Cutaway outline drawing illustrates construction of high-pressure unit: inlet and outlet respectively *A* and *B*, wire-mesh frame of radial fin *C*, reinforced core *D*, filter insert *E*, and retaining spring *F*. *Staynew Filter Corp, Rochester, N. Y.*

13 CONSTANT-LEVEL OILER — "Levomatic" automatically maintains oil level in ring and ball bearings of motors, line shafts, pumps and other machinery having oil wells. As oil is consumed in bearing chamber, it is automatically replaced with fresh oil from reservoir. *Trico Fuse Mfg Co, Milwaukee.*

LUBRICANT ADDITION—"Ball Roll" jelly-like lubricating compound is added to oil or grease through normal lubricating devices or points. Claimed to disperse through lubricant in minute particles, forming a semi-fluid oily layer on rotating or sliding parts with three times resistance to compression and nine times film strength of refined petroleum lubricant. *Lubco Corp, Chicago, Ill.*

ACID-RESISTANT ALLOY—"Hastelloys" *A*, *C* and *D* are particularly resistant to hydrochloric acid, nitric acid and free chlorine, and sulphuric acid, respectively. *A* nickel-molybdenum-iron alloy, *B*, nickel-molybdenum-chromium-iron alloy, and *C* cast alloy of nickel, silicon, copper and aluminum. *Haynes Stellite Co, Kokomo, Ind.*

MOTORS, SWITCHES AND OTHER ELECTRICAL EQUIPMENT



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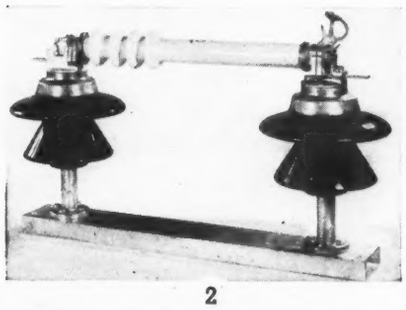

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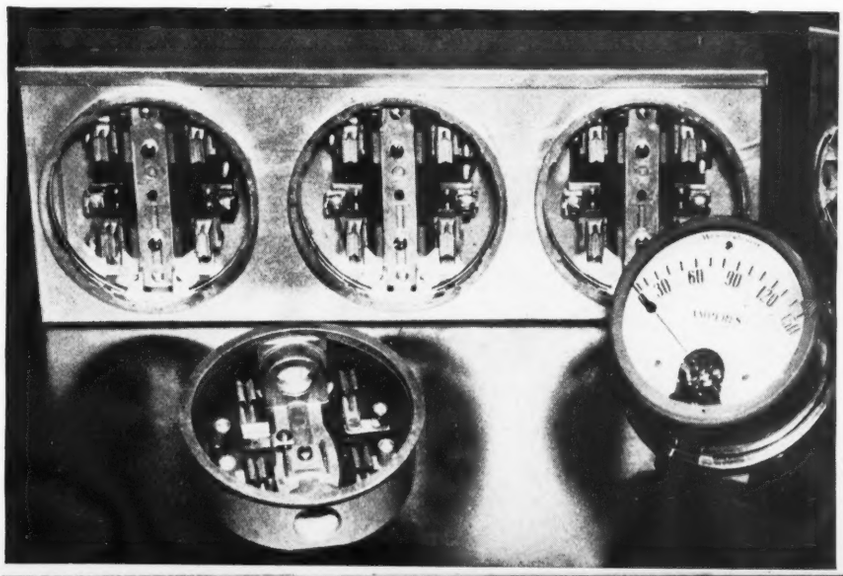

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1 VOLTAGE REGULATOR—For control of large synchronous machines or in modified form for large dc generators, Type J has rocking-contact, motor-operated rheostat with high-speed contactors and relays which adjust machine-field current by acting in exciter-field current. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

2 POWER FUSE—For service where short-circuit capacity does not exceed 600,000 3-phase kva, 34.5-kv, 200-amp disconnecting boric-acid "de-ion" power fuse is hinged at lower contact to open approximately 75 deg so it can be used as disconnect switch operated by standard hook-stick. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

3 PLUG-IN INSTRUMENTS — Detachable instruments consist of two units: a socket with electrical connection jaws, and instrument mechanism mounted on a plate having electrical connection blades on the back and enclosed in weatherproof glass housing. Advantages said to be: socket provides its own switchboard; various instruments can be plugged in same socket to obtain volts, amps, watts, power factor, kwhrs, etc; and sockets can be installed and sealed off to provide convenient outlets for future installation of instruments. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

1 MOTOR-GENERATOR BASE—Top, sides and base flange pressed from single sheet, reinforced with V-shaped ribs welded by electric-arc process. Ribs provide unusual strength and freedom from distortion, and all welds are stress-relieved after completion. *Reliance Electric & Engrg Co, 1088 Ivanhoe Rd, Cleveland.*

2 ELECTRIC PLIERS—For soldering lugs up to 1050 amp, or sweating pipe fittings up to 2½ in. in diameter under continuous operation (pipe fittings up to 4-in. diameter in intermittent operation). Large size pliers work evenly from both sides, eliminate fire hazard, sweat joint without unsweating adjacent connections, and hold work firmly while soldering. *Ideal Commutator Dresser Co, 1025 Park Ave., Sycamore, Ill.*

3 AUXILIARY RELAY—For either ac or dc circuits, "HGA" auxiliary relay can be furnished with operating coil from 1 to 5 amp dc, 6 to 250 volts dc, or 115 to 575 volts ac. Stationary contacts silver tipped and doweled to base to assure positive lineup with moving contacts, also silver tipped, which are mounted on a molded carrier attached to armature. Carrier forms barrier between movable contacts, increasing striking distance. *General Electric Co, Schenectady, N. Y.*

4 CAPACITOR—Power-factor correction capacitor consists of dielectric wound of laminations of thin linen paper interspersed with two aluminum-foil electrodes. Stack is insulated from clamp and case by layers of insulation, vacuum-dried and "Dykanol"-impregnated. 5, 10 or 15 kva with voltage ratings from 2300 to 6900 volts. *Cornell-Dubilier Corp, 4377 Bronx Blvd, New York, N. Y.*

5 BUSHING-CABLE TERMINATORS — For 7.5 to 30 kv, these terminators are designed to insure vacuum tightness under extreme conditions. Interchangeable stud connectors of hexagon hard-drawn copper rod; seating shoulders of laminated spring bronze engage recesses in hexagons. *Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.*

6 DRUM CONTROLLERS — For reversible ac squirrel-cage motors, reversible or non-reversible multi-speed squirrel-cage motors, machine tools, etc. Fractional-horsepower drum controller has removable case, insulated cylinder to which segments are secured without screws. *Cutler-Hammer, Inc, 294 N 12th St, Milwaukee, Wis.*

7 METAL-CLAD SWITCHGEAR—Illustrated is 50,000-kva switchgear in which oil circuit breaker has been lowered by handwheel to truck and is ready for removal. Lifting and lowering device in stationary element is self-contained mechanism which automatically places circuit breaker in correct position to engage primary and secondary disconnectors. *Delta-Star Electric Co, 2400 Fulton St, Chicago.*

8 TOTALLY-ENCLOSED MOTOR — Skeleton-type stator, deeply grooved on outside to increase radiation, has totally-enclosed ball-bearing endplates. External blower on front end directs cooling air around front endplate through a baffled back endplate down over bearing. Front end bearing carries thrust while back bearing is floating self-aligning type. *Wagner Electric Corp, 6400 Plymouth Ave, St. Louis, Mo.*

9 OIL CIRCUIT RECLOSER—For 4-amp, 2200- to 7500-volt current, this unit supplements line of "FP-19" reclosers. Automatic adjustment can be made for 1, 2 or 3 reclosures with 3 sec between operations. If fault is still in line after last reclosure, device locks open. Minimum tripping current 15 amp. *General Electric Co, Schenectady, N. Y.*

10 DISCONNECT SWITCH—3-pole, 15-kv, 1200-amp manual- or motor-operated switch for inverted mounting. Two fixed and one rotating insulators have flashover values of 85 kv dry, 50 kv wet. Rotating ball-bearing blade first raises to parallel position, then changes to lateral movement and enters fixed full-floating contact. *Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.*

11 RELAY-TRANSFORMER SETS — These units operate on "magnetic leakage" principle and produce own supply of low voltage for control circuit (20 volts). Transformers are built into relays to form compact unit. Of use where electrical loads to be handled exceed current-carrying capacity of sensitive control instruments. *Julien P Friez & Sons, Inc, Baltimore, Md.*

12 SQUIRREL-CAGE MOTOR — Motor frame contains two separate sets of air ducts, one internal and other external. Internal fan on rotor circulates warm air through internal ducts, walls of which are cooled by external fan blowing air through external ducts. *Westinghouse Electric & Mfg Co, E Pittsburgh.*

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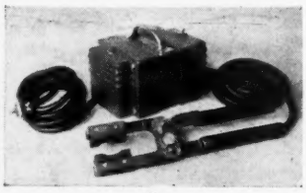

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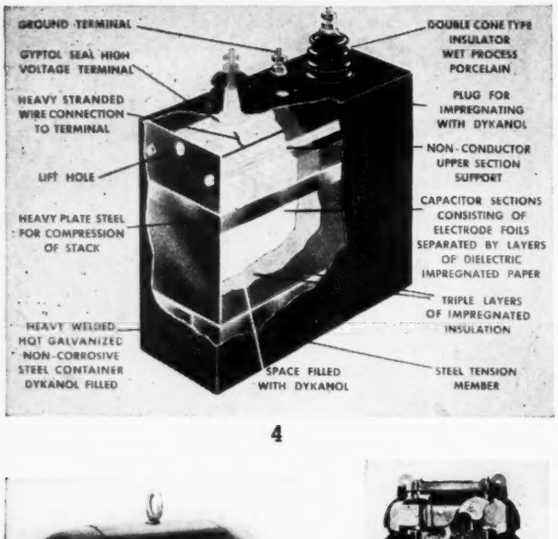
GROUND TERMINAL
GYPTOL SEAL HIGH VOLTAGE TERMINAL
HEAVY STRANDED WIRE CONNECTION TO TERMINAL
LIFT HOLE
HEAVY PLATE STEEL FOR COMPRESSION OF STACK
HEAVY WELDED HOT GALVANIZED NON-CORROSIVE STEEL CONTAINER DYKANOL FILLED
DOUBLE CONE TYPE INSULATOR WET PROCESS PORCELAIN
PLUG FOR IMPREGNATING WITH DYKANOL
NON-CONDUCTOR UPPER SECTION SUPPORT
CAPACITOR SECTIONS CONSISTING OF ELECTRODE FOILS SEPARATED BY LAYERS OF DIELECTRIC IMPREGNATED PAPER
TRIPLE LAYERS OF IMPREGNATED INSULATION
SPACE FILLED WITH DYKANOL
STEEL TENSION MEMBER

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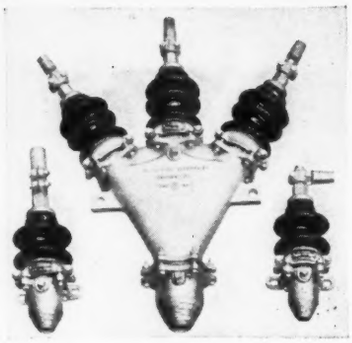

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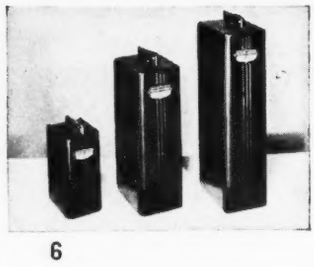

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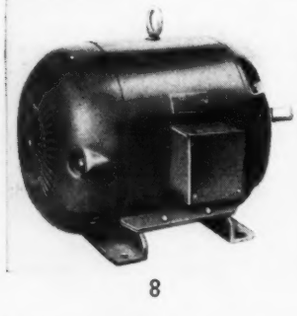

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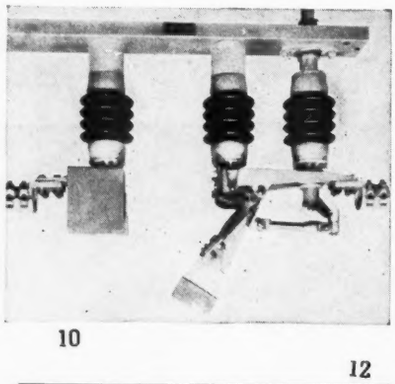

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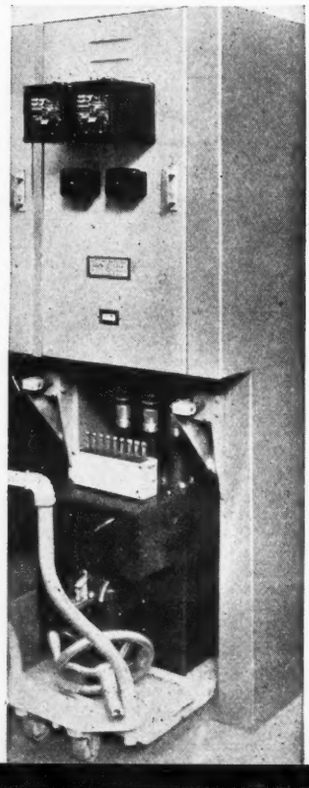

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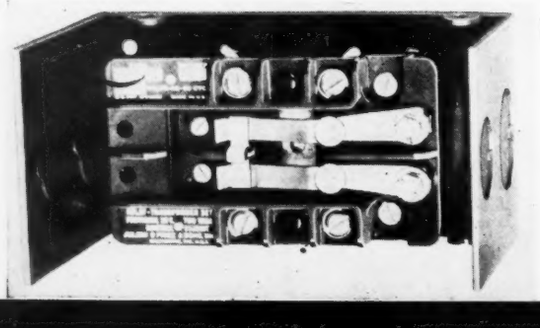

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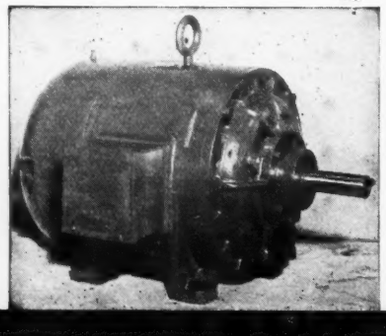


FOR THE MODERN POWER PLANT

Check List

of C-H Power Plant Control and other equipment

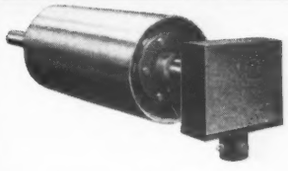
CONTROL FOR:

- Coal Unloading Machinery
- Conveyor Systems
- Coal Preparation Plants
- Magnetic Separators
- Water Supply
- Motorized Valve Control Systems—Water and Steam
- Water Treating
- Ventilation
- Elevators
- Ash Handling
- Service Cranes
- Boiler Feed and other Pumps
- Forced and Induced Draft Fans
- Stoker Control
- Motorized Steam Valves
- Safety Switches
- Etc., Etc., Etc.

● Tying in with the trend in other constructions, modern Power Plants are having more and more functions designed integrally with the structure, "built-in" instead of "hung on" later. Here are increased responsibilities for the civil and architectural engineer and construction firm alike.

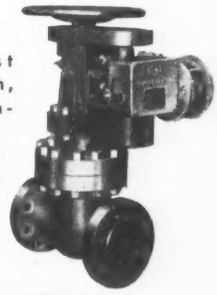
Mainly automatic, these new functions call for specialized electrical control knowledge of the highest, yet most practical, order. And Power Plant designers are turning, just as their brothers in other fields have turned, to Control Headquarters . . . for the consultory knowledge which is so thorough, so adequate and advanced. And they are specifying electrical control equipment by name—Cutler-Hammer—to save themselves time, trouble and expense. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1358 St. Paul Ave., Milwaukee, Wisconsin.

Consult with Cutler-Hammer Control Engineers in the planning stage. 44 years of specialization in electrical problems at your service.

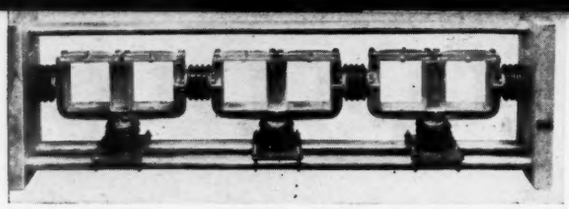


C-H Magnetic Separator famed throughout Industry.

The most thorough, most completely engineered lineofValve Control.



C-H 9586 Starter. Standard for thousands of applications.



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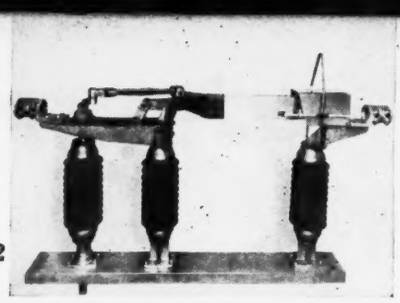

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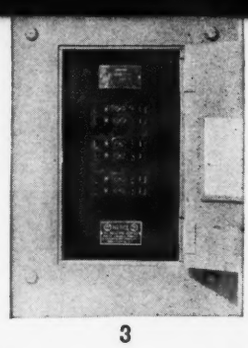

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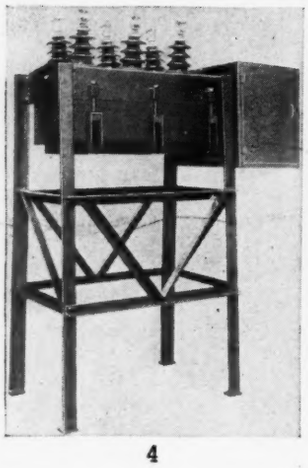

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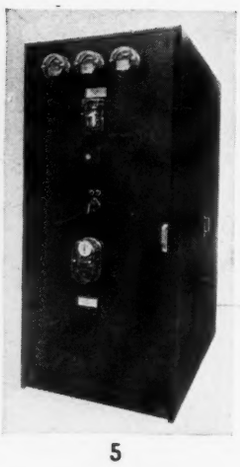

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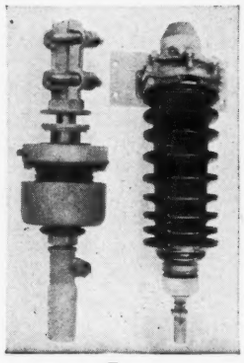

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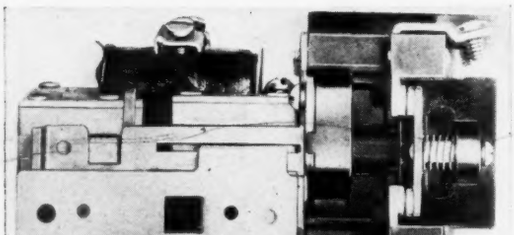

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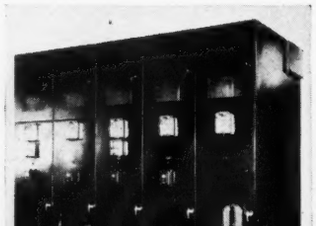

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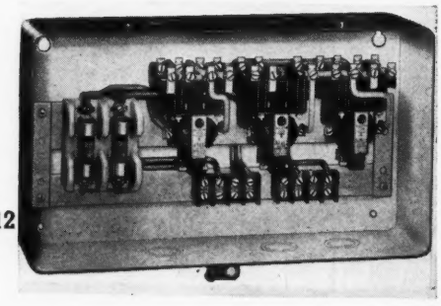


12

1 BUS SUPPORT—3-phase self-contained unit for mill service is 75 in. long and supports six (2 per phase) hollow-square, ventilated 6-in. copper conductors on a short 220-volt switchboard bus. Clamps have rollers to permit bus expansion without stressing porcelain insulators. *Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.*

2 AIR-BREAK SWITCH — Blade-operating mechanism constructed to lock levers and linkages securely after initial setting is made. Future blade adjustments are made on interconnecting steel pipes underneath mounting base. Rated 2000 amp, 34.5 kv. *Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.*

3 CIRCUIT-BREAKER PANELBOARD — "Nofuze" panelboard designed for 115-, 115/230-volt ac service in a range of 4 to 40 circuits in two circuit steps. Bus arrangements are provided for single-phase, 3-phase, 2-wire, and 3-phase, 4-wire services, with branch circuit ratings of 15 to 50 amp. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

4 OIL CIRCUIT BREAKERS—Operate on oil-blast principle and are identified as types FLO-1A, -1B, and -1C for interrupting ratings of 50,000, 100,000 and 175,000 kva respectively at 15,000 volts. Horizontal break with three poles in single rectangular steel tank. *General Electric, Schenectady, N. Y.*

5 SWITCHGEAR—Used for across-the-line control of a 400-hp, 220-volt, 3-phase squirrel-cage induction motor driving a 250-kw dc generator and 20-kw exciter. Front hinged door carries overload, under voltage, temperature relays, control switch, etc. *Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.*

6 MOTOR—Vertical, hollow-shaft, squirrel-cage, low-starting-current induction motor for deep-well pumping has simplified oiling system, ball-type guide bearing, high full-load speed, adequate starting torque, double-end ventilation, and full mechanical protection. *General Electric Co, Schenectady, N. Y.*

7 CABLE TERMINATOR—For use on oil-pressure cable. Lower end has standard wiping sleeve, top and expansion stud. Expansion member is oil-tight bronze bellows gasketed to external parts, and permits free expansion and contraction. Internal connector clamp is double-U bolt. 46 kv, 750 amp. *Delta-Star Electric Co, 2400 Fulton St, Chicago.*

8 MAGNETIC CONTACTOR—Ac multipole contactor, for controlling small single-phase and polyphase motors, or as flexible relaying device for comprehensive control systems, has double-break silver contacts, layer-wound coils, and laminated magnet. *General Electric Co, Schenectady, N. Y.*

9 ANGLE CLAMP—For distribution and industrial-plant lines, this clamp permits angles of 30 to 120 deg to be turned without deadending conductors and using jumpers. May be attached to an eye, clevis or hook-type suspension insulator without intermediate fittings. *Ohio Brass Co, Mansfield, Ohio.*

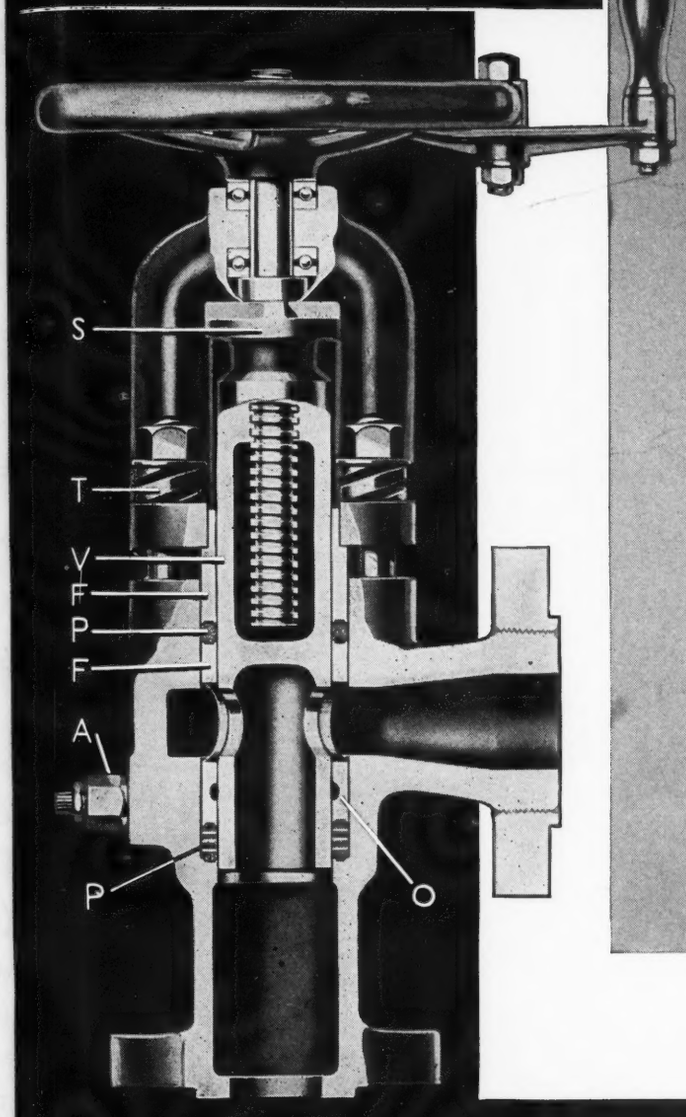
10 SWITCHGEAR UNITS—For small industrial installations or auxiliary circuits in steam power plants, metal-enclosed switchgear has cubicles in which are mounted breakers, buses, disconnecting switches, transformers and similar auxiliaries. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

11 DISCONNECT SWITCH—4000-amp, 23-kv outdoor-form, multiple-blade, straight-line disconnect switch is equipped with blade locks and silver-to-silver contacts. One terminal for heavy copper tubing, other for flat bars. *Delta-Star Electric Co, 2400 Fulton St, Chicago.*

12 AUTOMATIC ALTERNATOR—For duplex pumps. Three "Bulletin 700" relays automatically switch float-switch control circuit from one pump starter to the other each time unit operates. Panel may be used also with two float switches so that idle pump can be used as automatic booster. *Allen-Bradley Co, 1311 S First St, Milwaukee, Wis.*

YARWAY EQUIPPED...

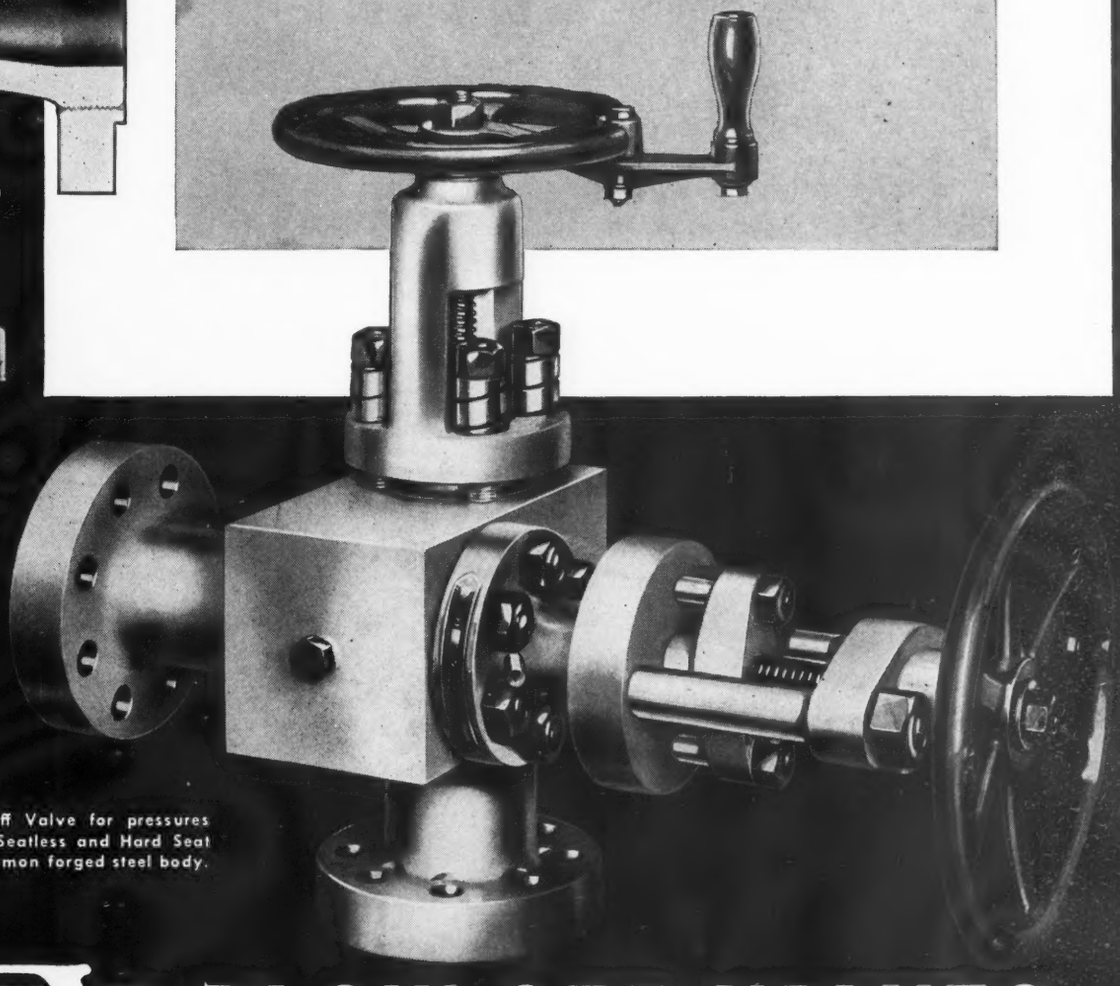
A Mark of Good Engineering



Yarway Seatless Blow-off Valve. Operation: After Valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packing P above and below port. Annular groove O connects with Alemite fitting A for lubricating plunger and packing. Yoke springs T maintain continuous pressure through follower gland F on packing rings P.

Yarway Blow-off Valves are used singly or in tandem in more than 10,000 plants in 67 different industries . . . Regarded as a standard of quality by leading steam plant designers and builders of steam generating equipment . . . Selected for Federal, State and Municipal Institutions . . . Built for all pressures up to 2,000 lbs.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia



Yarway Unit Tandem Blow-off Valve for pressures from 600 lbs. to 1500 lbs. A Seatless and Hard Seat Valve combination using a common forged steel body.

YARWAY BLOW-OFF VALVES

1 ELECTRONIC VOLTAGE REGULATORS —Two models, 5601 and 5602, are controlled rectifiers deriving power from ac generator and delivering rectified dc current to shunt field of exciter in an amount which is function of ac-generator potential. No moving parts; stream of electrons controls regulating action. Corrective action of regulator 5601 starts within 1/120th sec of slightest change in generator voltage, regulator 5602 within 1/60th sec. *Ward Leonard Electric Co, Mt Vernon, N. Y.*

2 TRANSFORMER RECTIFIER—Model 9980 combines 110-volt ac transformer and a copper-oxide rectifier and is designed to provide 6-volt dc for power-relay operation. Output of transformer is 120 milliamps continuous, or 200 intermittent. Resistor across output protects sensitive relay contacts from "kick-back" voltage. *Weston Electrical Instrument Corp, Newark, N. J.*

3 DIRECTIONAL OVERCURRENT RELAY—Two transformers, connected in open delta, permit directional relaying of ground faults. Overcurrent element has tap range of 4 to 15 amp and operates from zero sequence current. Directional element operates from negative phase sequence voltage and current derived from filters. Will operate on 4 amp, 1 volt in phase. Eight terminals, shockproof gravity target, full glass cover. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

4 CIRCUIT-BREAKER MECHANISM — A portable operating mechanism for "FH" oil circuit breakers has larger opening springs and modified trip mechanism to reduce friction and shorten opening time. Hydraulic manual-closing device, easily-aligned centrifugal mechanism, and adjustable cutoff switch. *General Electric Co, Schenectady, N. Y.*

5 OIL CIRCUIT BREAKERS—For industrial and central-station use where minimum space is available, 50,000-kva breakers are manually or electrically operated, non-automatic or automatic, single throw with adaptable mounting arrangements. "De-ion" interrupter contacts, condenser bushings, single square tank, hydraulic bumpers, and silver-to-silver main contacts. Rated 600 amp, 15 kv; 1200 amp, 7.5 kv; and 2,000 amp, 5 kv. Either 2- or 3-pole single throw. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

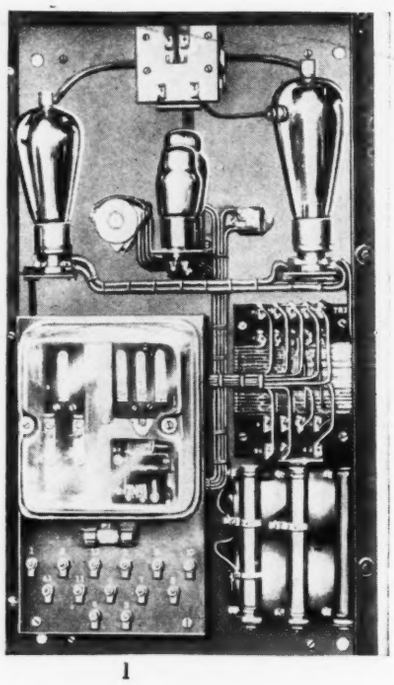
6 WIRE STRIPPER—Springless unit strips either from left to right or right to left. Double-edge blades in stripping chambe. close to within 0.001 in. of diameter set by dialed micrometer gage, strip insulation, twist wire and polish. Powered by ¼-hp motor. Flexible metal tube carries waste strippings to disposal chamber. *Ideal Commutator Dresser Co, 1025 Park Ave., Sycamore, Ill.*

7 FRACTIONAL-HP MOTORS—Size range of 1/6 to ¾ hp. Repulsion-start induction, split-phase, capacitor, polyphase, and dc. Interchangeable mounting dimensions for a given horsepower size. *Century Electric Co, St. Louis, Mo.*

8 LEVER MOTOR—For dampers, lever-operated and with butter-fly valves, electric rheostat for variable-speed motors, etc, this all-steel welded lever motor has deep diaphragm to give smooth modulated action. Power of either up- or down-stroke action can be increased or decreased by spring-adjusting nut. Lever action can be reversed by substituting another lever and transposing fixed and movable pivots. May be operated by remote manual control, electro-pneumatic switch, or by pneumatic controller. *Taylor Instrument Cos, Rochester, N. Y.*

HUMLESS CONTACTOR — Dc-operated ac contactors developed for office buildings, central-station substations, theatres, etc. Only small amount of power is required to hold circuit closed. Unaffected by normal voltage variations; current-carrying parts rated on 8-hr basis at 600 volts, and they can be used on either ac, through rectifiers, or directly on dc. Heavy copper contact tips minimize arc burning. Heavy steel spring maintains constant pressure on tips to minimize contact resistance. Tips are removable for inspection. *General Electric Co, Schenectady, N. Y.*

PUSHBUTTON CONTROL — Bulletin 800 heavy-duty control stations, of surface and flush-mounting types, have maximum dc rating 2.5 amp. 115 volts; 12.5 amp, 230 volts; 0.25 amp, 550 volts. Maximum ac rating: 10 amp, 110-220-440-550 volts. Modernistic black enameled pressed-steel enclosing box, with multiple knockouts on top and bottom. *Allen-Bradley Co, 1311 S First St, Milwaukee, Wis.*



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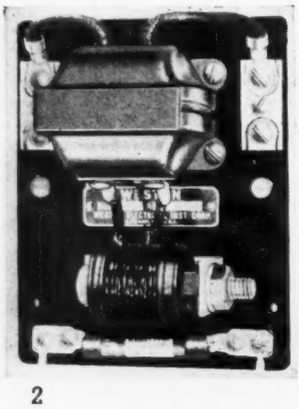

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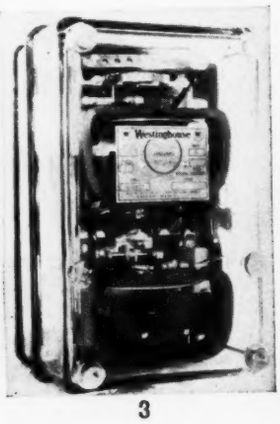

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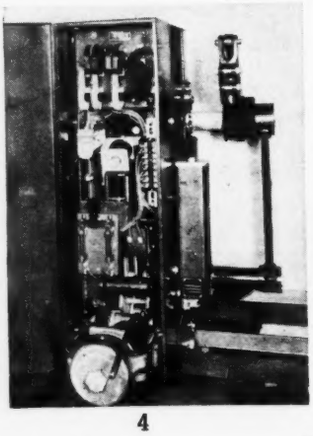

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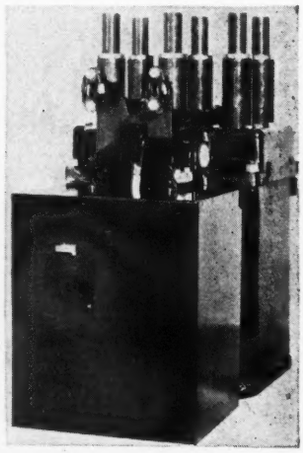

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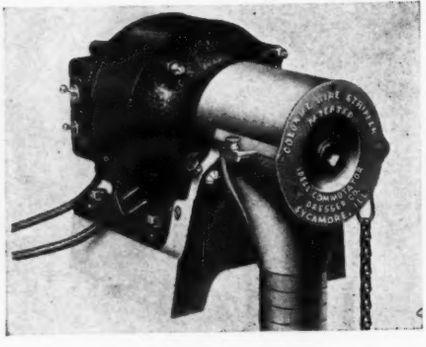

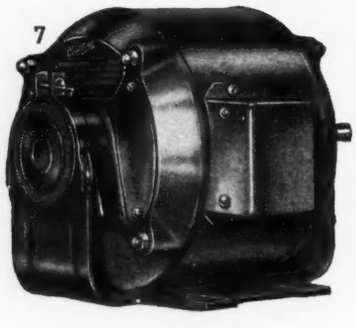

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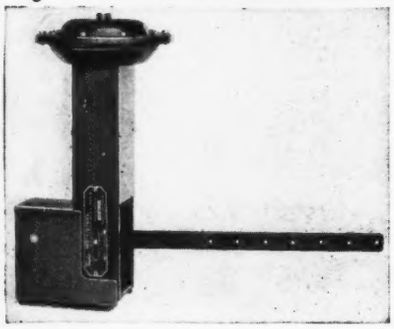
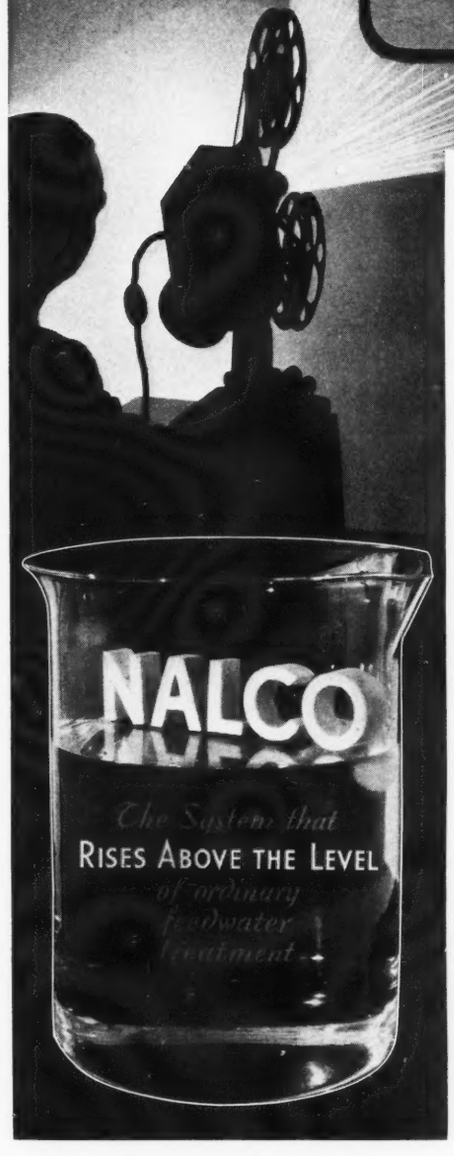




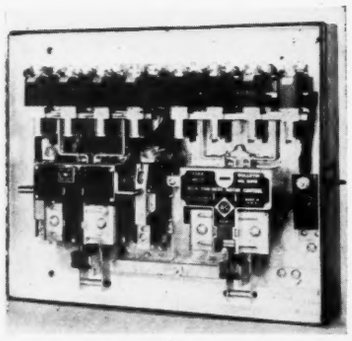
PICTURE

of a man cleaning a boiler (The NALCO Way)

WE don't recommend that boiler room engineers spend their time sitting around loafing, but we do want to point out that they will have more time for other things—more profitable than cleaning boilers—when they use the Nalco System of Feedwater Treatment. This is the *COMPLETE* water treating service. Use it for keeping economizers ... pumps ... heaters ... feed lines clean, too! No equipment to buy, no additional capital investment required. Write for information today.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place Chicago, Illinois

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico*, should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, England. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay Street, Toronto, Ontario.



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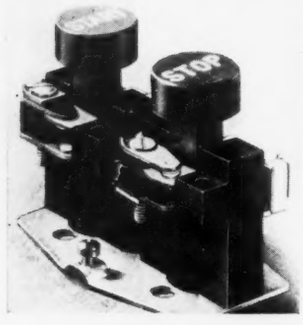

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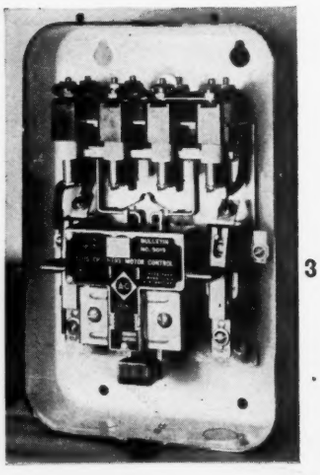

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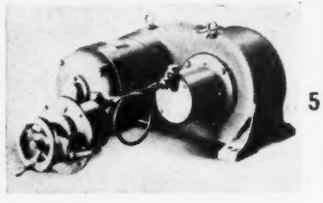

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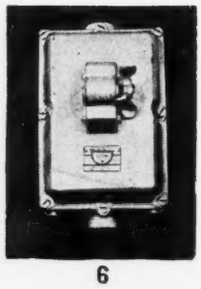

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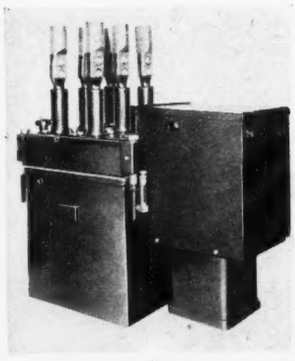

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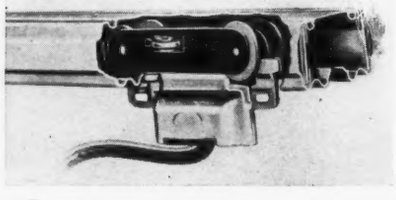

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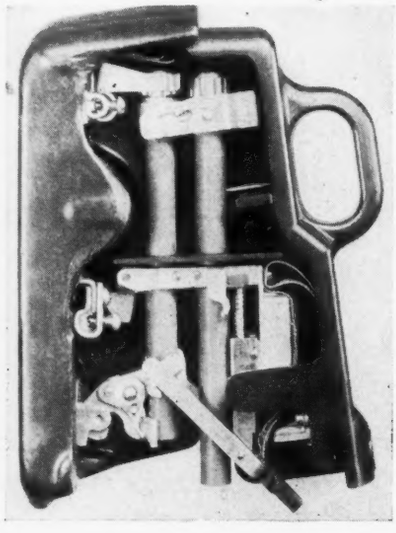


1 REVERSING MOTOR STARTER—AP-7-R, 7½ hp, 550 volts, or less, has two motor-starter units mechanically interlocked so that one unit cannot be closed if other is closed. Starter units have enclosing chambers which confine and depotentiate arc formed by circuit interruption. Large silver double-break contacts, solenoid vertical make and break, individual molded pole units on steel chassis, and enclosed temperature overload relays to give positive motor protection. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

2 PUSH-BUTTON CONTROL—Silver contacts mounted on Bakelite base. Box and cover die cast. Box is tapped for conduit entrance, and wiring may be made by removing cover without disturbing conduit connections. Colored molded-Bakelite buttons, *Monitor Controller Co, Baltimore, Md.*

3 MOTOR STARTER—Type AP-7 across-the-line motor starter equipped with special "Ruptor" enclosing chambers which confine and depotentiate arc formed by circuit interruption. Vertical make-and-break, enclosed temperature overload relays, individual pole units mounted on steel chassis, large silver double-break contacts, and pilot circuit isolated from motor circuit. Sizes: 7½ hp at 440 and 550 volts, 5 hp at 220 volts, and 3 hp at 110 volts. *Allis-Chalmers Mfg Co, Milwaukee.*

4 MERCURY SWITCHES—"Staley" switches have mercury-to-mercury make-and-break contact housed in hydrogen-filled metallic envelope. Operated by tilting through angle of about 10 deg from horizontal. Reversing switch in its clips provides reversal of circuit function (make instead of break). 5-, 10- or 15-amp capacities. Low contact resistance, reliability of operation, long life, and freedom from breakage. *Electric Switch Corp, Columbus, Ind.*

5 VARIABLE-SPEED MOTOR — Hydraulic remote control provides smooth regulation and an infinite number of speeds within range specified. Liquid at remote-control cylinder is forced through copper tubing to cylinder at variable-speed unit; movement of this cylinder changes speed. Controlled through handwheel shown. *U S Electrical Motors, Inc, 200 East Slauson Ave., Los Angeles, California.*

6 EXPLOSION-PROOF MOTOR STARTERS —For control and protection of single-phase and polyphase squirrel-cage motors, Westinghouse manual across-the-line starters provide overload protection with disk thermostat. Quick make-and-break toggle-type mechanism, trip-free handle, front operated. Ratings varied by changing heaters. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

7 MOBILE OUTLET FOR ELECTRIC POWER—"Trol-E-Duct" consists of section lengths of formed electroplated sheet-steel duct in which are enclosed copper bus bars partially wrapped in insulating material. A narrow slot extending along one side of duct permits insertion of movable current collectors and stationary twistout plugs to which can be wired tools, lights and appliances. With standard couplings, elbows, hangers and other fittings, duct sections can be assembled and installed as compact, continuous flexible distribution system. *Bull Dog Electric Products Co, 7610 Jos Campau Ave, Detroit, Mich.*

8 RECLOSING FUSE CUTOUT—Reclosing door of unit contains two fuse holders. Should first fuse link blow, door is pushed outward at bottom. After time lag of one sec, other fuse holder with its link is connected, thus restoring service if fault is temporary. Should second fuse blow, complete door drops open and is isolated from circuit. If fault still persists, or when another short circuit occurs before blown fuse link is replaced, inner fuse will blow, releasing toggle mechanism and permitting door and fuse holder to drop to open position. Rated 50 amp, 5000 volts and 7500/12,500 grounded Y volts. *General Electric Co, Schenectady, N. Y.*

9 OIL-BLAST CIRCUIT BREAKER—Type FK-45, 75,000-kva interrupting rating, is a non-oil-throwing breaker with plate-steel rectangular tank, separating chamber, silver-to-silver main contacts, renewable arcing contacts, oil-blast baffles, and "Herkolite" bushings. Three current sizes, 600, 1200 and 200 amps. *General Electric Co, Schenectady, N. Y.*

10 MINIATURE PANEL INSTRUMENTS —For use as ammeters, voltmeters, power-level meters and volt ohmmeters, either ac or dc, entire line employs only two types of mechanism, providing easy interchangeability of parts. Capacities as low as 20 microamperes in moving-coil types. Rated 750 volts. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

INSULATED CABLE — Insulating compound "Flamenol", a synthetic substance similar to rubber in its characteristics, but will not burn and is highly resistant to moisture, acids, alkalies and oils. "Flamenol"-insulated cable designed for power and control circuits at 600 volts and less, and for operation at a maximum copper temperature of 60 C. *General Electric Co, Schenectady, N. Y.*

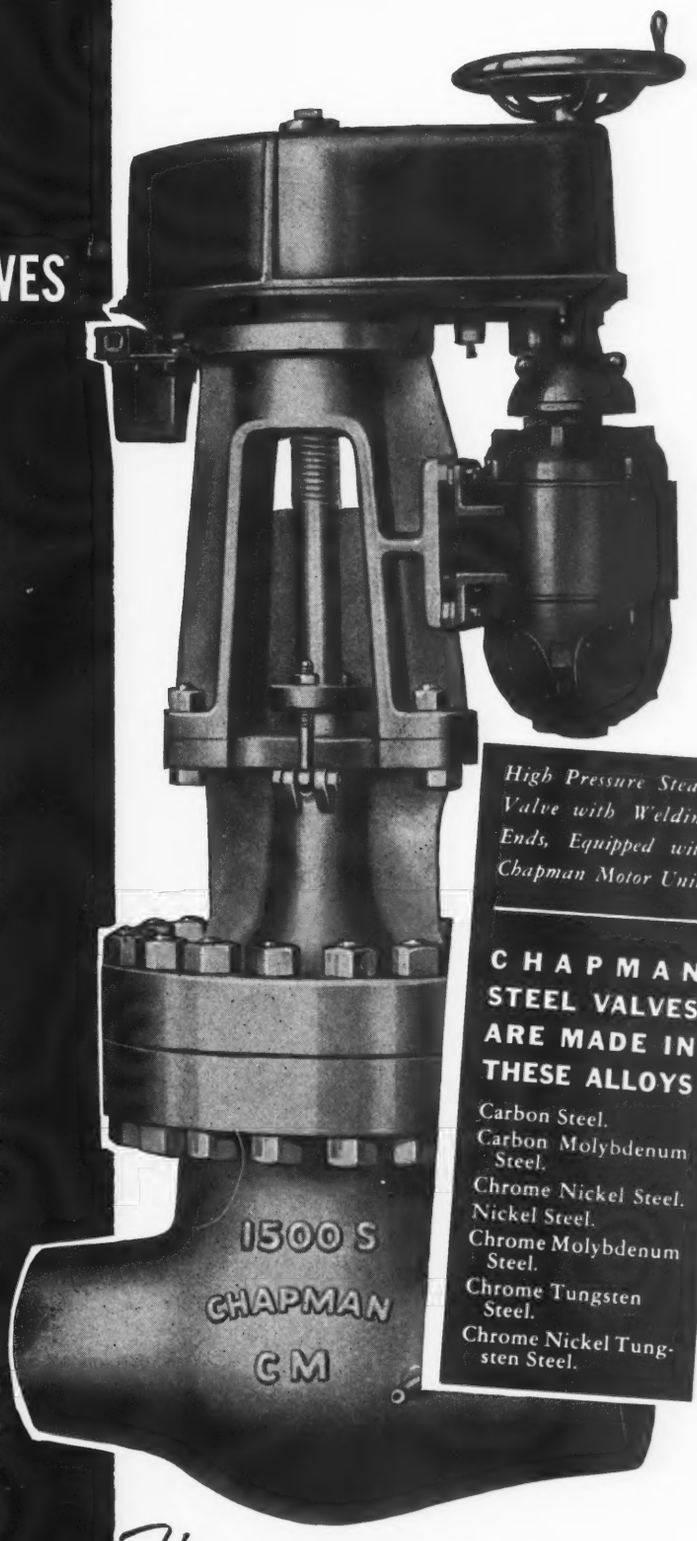
Chapman

BUILDS POWER PLANT VALVES THIS WAY

Right from the start, Chapman *borrows* trouble in making power plant valves to eliminate trouble in service. Chapman shops the country over for top quality in raw materials. Their metallurgical engineers supervise—and double-check—every pound of steel melted in special electric furnaces, in Chapman's own foundries. Then strength-tested castings are turned over to master machine-craftsmen who work to decimals that *predetermine* permanent accuracy.

All this means extra time and trouble—but it means valves that you can count on for long years of trouble-free service under today's high temperatures and pressures.

You can obtain this premium quality in valves of any type . . . in any of the steels listed . . . that you may need in any branch of plant operation. Equipped with any type of operating mechanism. Ask for full information and prices.



High Pressure Steam Valve with Welding Ends, Equipped with Chapman Motor Unit.

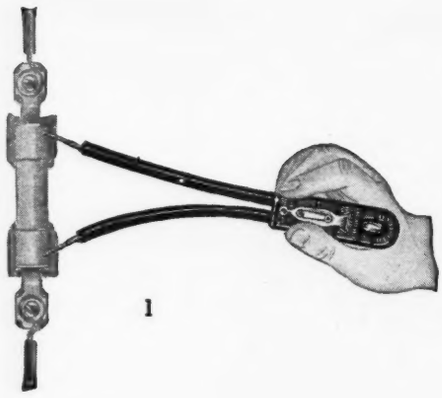
CHAPMAN STEEL VALVES ARE MADE IN THESE ALLOYS

Carbon Steel.
Carbon Molybdenum Steel.
Chrome Nickel Steel.
Nickel Steel.
Chrome Molybdenum Steel.
Chrome Tungsten Steel.
Chrome Nickel Tungsten Steel.

The
CHAPMAN VALVE
MANUFACTURING COMPANY

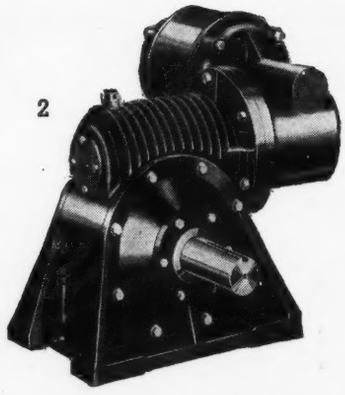
INDIAN ORCHARD, MASSACHUSETTS, U. S. A.

1 ELECTRICAL-CIRCUIT TESTING INSTRUMENT—Improved "Test-O-Lite" has pocket clip for holding instrument in pocket. Also sensitivity has been improved so that instrument detects pressure of voltage between 90 and 500 volts ac or dc by small neon lamp in body of tester. For locating burnt-out fuses, leaks, short or open circuits, or wiring defects. *L S Branch Mfg Corp, 55 Dickerson St, Newark, N. J.*



1

2 FRACTIONAL-HP GEAR MOTORS—"IXL" motorized speed reducers range from 1/50 to ¾ hp in ratios from 2 to 1 up to 8000 to 1. High-carbon alloy-steel shafts, anti-friction bearings, and automatic lubrication. *Foote Bros Gear & Machine Corp, 5301 Southwestern Blvd, Chicago, Ill.*

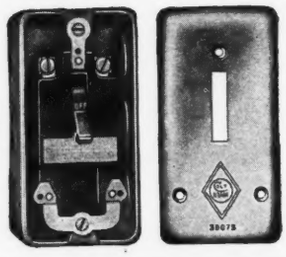


2

3 CIRCUIT BREAKER — "Yoke - Mounted Protectit" auxiliary circuit breaker for maximum voltage of 250 volts ac or dc and a maximum of 1 hp. Made as fixed-capacity device in 10 differently rated sizes or as a variable unit with 20 different interchangeable heater elements. Standard mounting. *Colt's Patent Fire Arms Mfg Co, Hartford, Conn.*

4 THERMAL OVERLOAD MOTOR SWITCH — For fractional-hp motors, "Thermotector" consists of thermostatic bimetallic helix, heater helix, flat steel spring, and contact arm. When helix is heated above normal, free end rotates and reverses bow of spring. As spring passes dead center, it moves contact arm and disconnects motor. Automatically reconnects after temperature has reached normal again, or may be obtained with manual reset. *General Electric Co, Schenectady, N. Y.*

OVERLOAD PROTECTION FOR AC MOTORS—"Thermo-Magnetic Overload Feature" applicable to all ac I-T-E motor-protecting circuit breakers. Standard devices available for any ac motor up to 1000 hp, 550 volts. Overload protector has electro magnet excited by current flowing in series overload coil, bimetal thermal element mounted at back of magnet and heated by current induced in a short-circuited turn of copper adjacent to it, and hinged laminated iron armature which works in conjunction with magnet and is tripped during overload conditions. *I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Philadelphia, Pa.*



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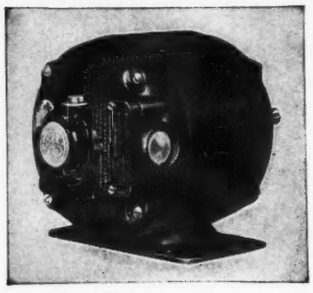
INDICATING FUSES—Renewable fuses have neon light permanently attached which glows when fuse blows out. Neon light is encased within handle secured to fuse, and also serves as a handle in extracting fuse. Either knife-blade or ferrule type, 250 to 600 volts, 3 to 600 amp. *Indicator Corp, 32-36 Green St, Newark, N. J.*



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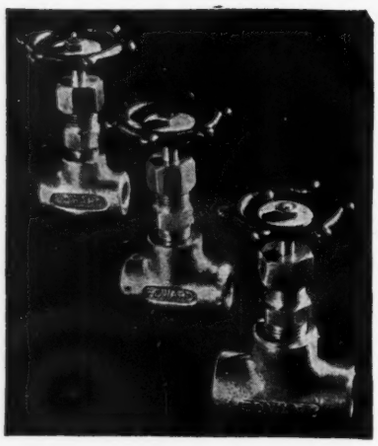
PIPING, FITTINGS AND VALVES



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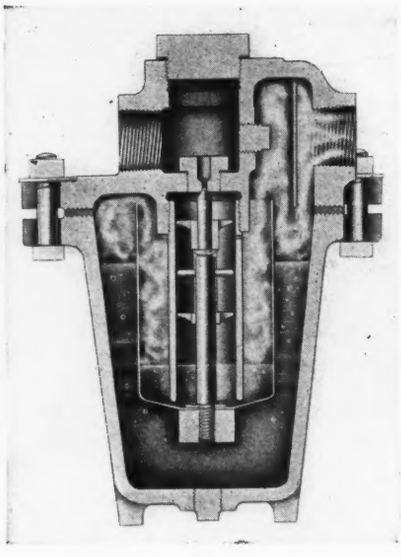

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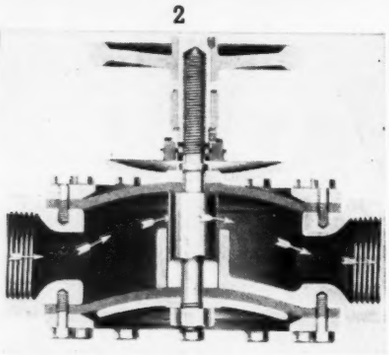

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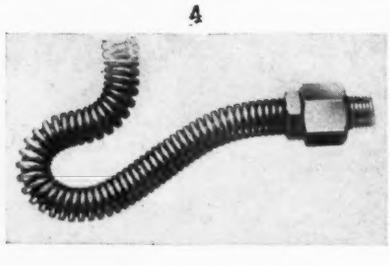

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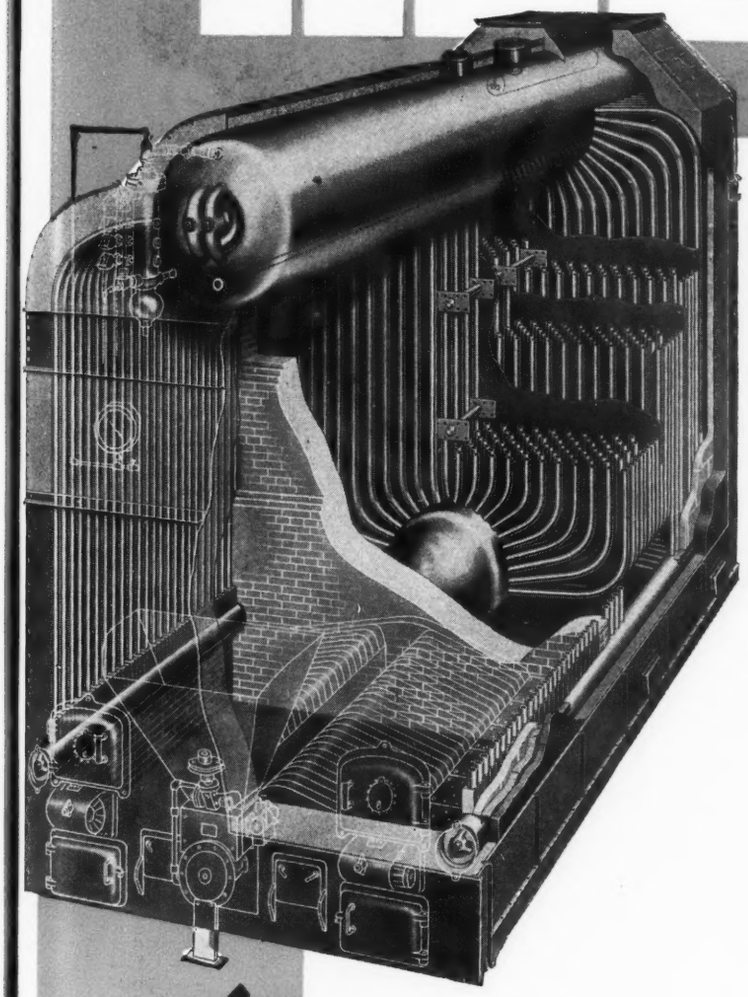
1 GAGE VALVES—New line of forged-body valves with oversize handwheels and long taper-threaded bonnet joints. Working pressure ratings are from 4000 lb at 150 F to 475 lb at 1000 F. Available in sizes from ⅛ to 1 in. in carbon and alloy steels. *Edward Valve & Mfg Co, Inc, East Chicago, Ind.*

2 BALANCED-DIAPHRAGM VALVE—Balanced valve eliminates bellows and stuffing boxes. Unnecessary to remove valve from line to change diaphragm, which can be supplied of various compositions for air, water, gas, acids, or alkalis. Impregnable against freezing; either hand or motor operated. 2-in. size and larger. *McAlear Mfg Co, 1901 Southwestern Ave, Chicago, Ill.*

3 STEAM TRAP—Bucket-type steam trap designed for straight-line installation, which permits inspection and cleaning without disturbing pipe connections. Plug at top gives access to seat. Only two moving parts: bucket and seat, which affords quick positive action. Positive water seal prevents blowing steam. For condensate drainage up to 150 lb. *Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.*

4 SEAMLESS TUBING — TST "Triple Safe Tubing" is a flexible metal hose with its metal braid embedded between two corrugated seamless tubes, forming an all-metal, weldless, jointless and packless tubing. Can be cut with hacksaw, and fittings attached. Made of bronze alloy, and to order in aluminum. Standard sizes are ¼, 5/16, ⅜ and ½ in. in diameter. *Seamlex Co, 5-19 48th Ave, Long Island City, N. Y.*

KEELER



Patent No. 2,097,268

TYPE CP STEAM GENERATOR

84.5% Efficiency at 125% of Rating . . . 82.63% Efficiency at 203% of Rating without using an economizer or preheated air.

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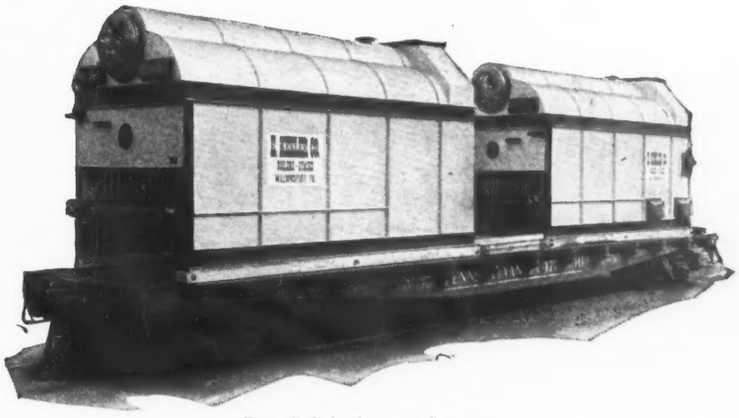
One hundred and sixty C P Boilers, 50 H.P. to 550 H.P., are either in operation or under construction.



Two C P boilers on flat car.

SEND FOR BULLETIN F-9

E. KEELER COMPANY

BUILDERS OF BETTER BOILERS

WILLIAMSPORT, PENNA.

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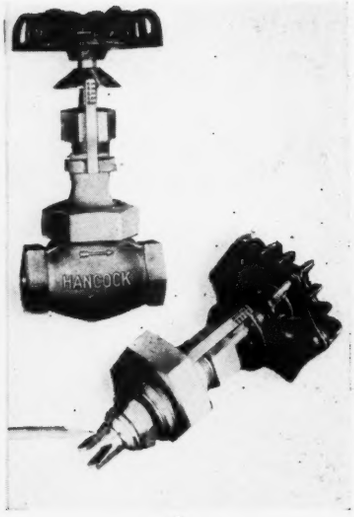

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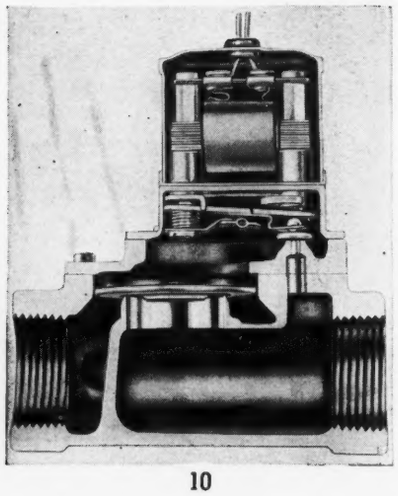

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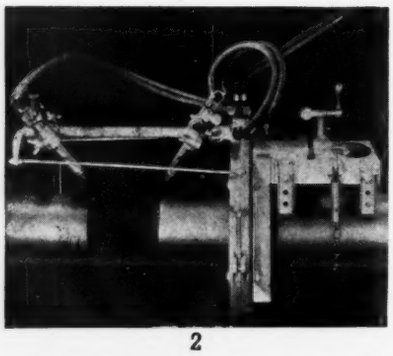

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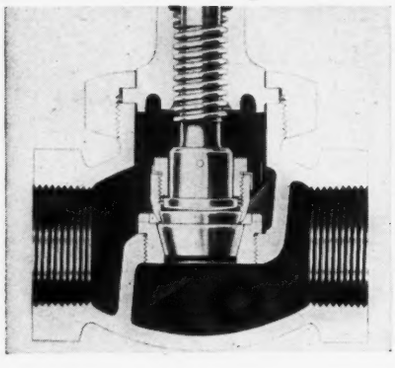

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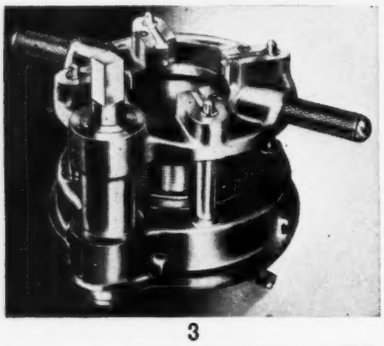

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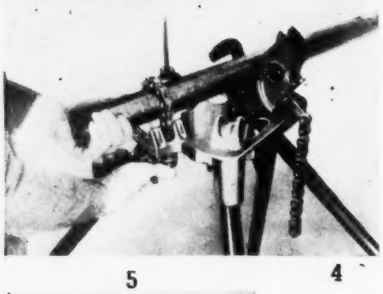

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1 SEVERE-SERVICE VALVE—"Dura-valve" for high-temperature and high-pressure service, has internal Stellite seats. Desing permits Stellite seat facing to be easily welded in and serviced even on small size valves. Made in one basic size, and then tapped or bored for welding, for ½-, ¾- or 1-in. pipe. *Hancock Valve Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn.*

2 PIPE - CUTTING MACHINE — "Oxweld Type CM-13" cuts and bevels pipe by oxyacetylene process. Needs only one man to operate it, including setting up of machine, performing cutting operation, and removing machine from pipe. Channel ring fits around pipe, and ring and blowpipe can rotate around entire circumference of pipe in one cut. Additional blowpipe can be mounted on tube-extension arm for double cutting or beveling. Made in one size for cutting 8-, 10- and 12-in. pipe. *Linde Air Products Co, 205 E 42nd St, New York, N. Y.*

3 PIPE THREADER—Model 48-R threads 2½-, 3-, 3½- and 4-in. pipe. Extra wide die has wide throat to center and hold tool on pipe. Fully-enclosed gears keep out chips and dirt. Driving pinion is straddle-mounted, with bearings both above and below gear teeth on pinion. Proper position for setting dies to cut standard thread is marked by shoulder on tapered post. Net weight 58 lb; cuts right-hand American thread. *Beaver Pipe Tools, Inc, Warren, Ohio.*

4 PIPE TOOL — Portable "Vulcan" vise stand No. V-1 combines vise stand, chain pipe vise, and a pipe bender. Legs of 1-in. pipe with upset feet which fold for carrying and are held together by tie chain. Vise jaw is of tool steel and base of malleable iron. Stand weight 35 lb and takes pipe from ⅛ to 2 in. in diameter. Pipe bender handles pipe up to ¾ in. *J H Williams & Co, 75 Spring St, New York, N. Y.*

5 MAGNETIC VALVE — "Lever - Action" magnetic valve is designed for control of oils as heavy as No. 6 at room temperature, water, air and gas up to 140-lb pressure, and steam up to 125 lb. Valve closes with pressure on top of seat to insure tight closing. Solenoids are removable and coils are waterproof. Terminal connection rotates for ease in wiring. *General Controls Co, 267 5th Ave, New York.*

6 GATE VALVES—Made of carbon-molybdenum steel for 150 and 300-lb steam pressure. Heavy wall thickness, deep stuffing boxes, oversize stems, streamline flow and steel handwheels with fluted non-slip rims. *Walworth Co, 60 E 42nd St, New York, N. Y.*

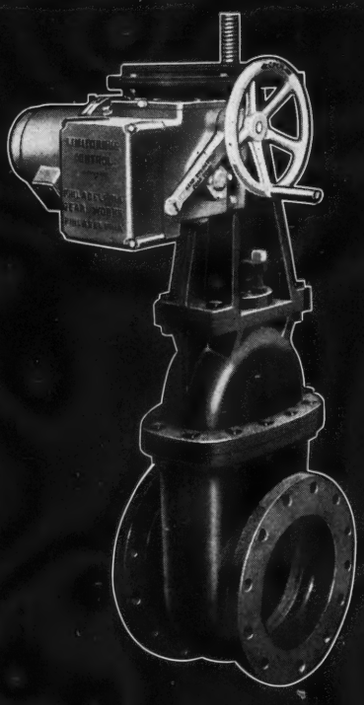
7 VALVE RESEATER—Cutting tool removes old seat, and at same time, threads a hole for inserting new seat made with an interlocking ground joint to provide leak-proof connection with base of valve. 15-part kit contains all reseating tools. Seats in sizes up to 5 in. in diameter. *Standard Reseater Corp, 423 W 126th St, New York, N. Y.*

8 FLOW - CONTROL AND SHUTOFF VALVE—Bronze "Flocontrol" valves are combination of flow instrument and shutoff valve. Stainless-steel valve seats and disks of 500 Brinell hardness. Union bonnet valve body. For maintaining close control on oil-burner lines, water-treating systems, cooling-water lines to turbines and air compressors. *Hancock Valve Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn.*

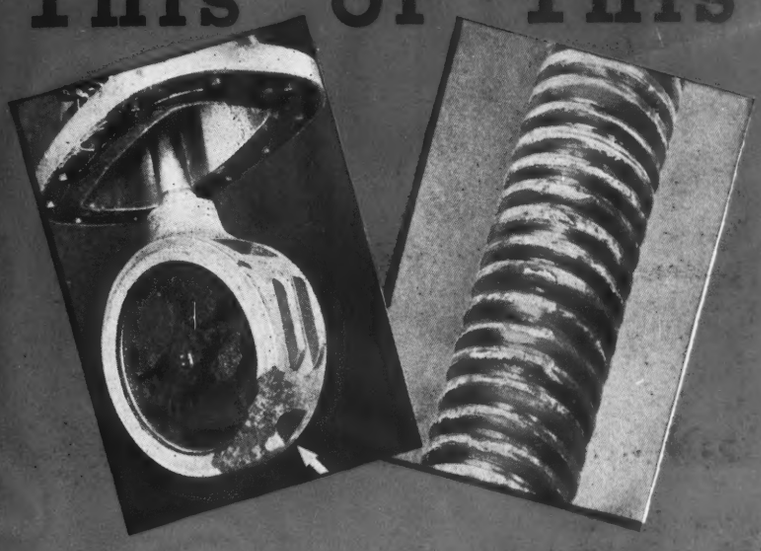
9 PLUG VALVE—Plug and seat ring made of Jenkins "JX500", a stainless steel having Brinnel hardness over 500. Valve designed for severe service as continuous throttling for pressure reduction or free blow duty as soot blowers, injectors, heating coils, or any steam line where close regulation is required. *Jenkins Bros, 80 White St, New York, N. Y.*

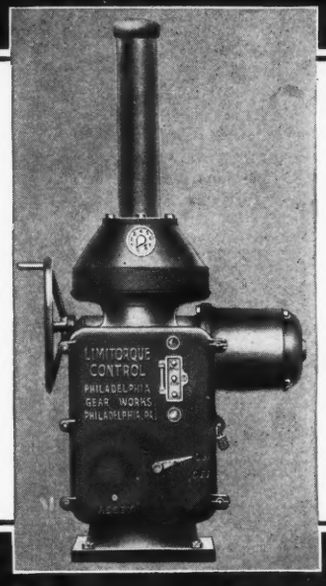
10 MAGNETIC GAS VALVE—Small disk floats in chamber. When control instrument through electromagnet lifts bleeder valve, pressure above disk is released to downstream side. Incoming gas then lifts floating disk to top of chamber, and as long as bleeder valve is open, disk is held up. When control instrument is satisfied, relay closes bleeder valve in a fraction of a second. Bronze valve body, aluminum floating disk, and leather seats on floating and bleeder valves. 6-volt ac current. *Julien P Friez & Sons, Inc, Baltimore, Md.*

ALWAYS ON GUARD AGAINST This or This



LIMITORQUE
AUTOMATIC VALVE
CONTROL





For installations where it is not advisable to attach the control unit directly to the valve yoke, Floor Stand Controls can be supplied. Usually these are mounted directly over the gate stem although other locations are possible.

Bent Valve Stems . . . Valve Gates chipped or damaged otherwise, are serious matters that cause expensive replacements, inconvenient shut downs and general disruption of schedules. And, these are but some of the troubles that can follow improper valve seating or the valve gate's meeting an obstruction during the closing operation.

Philadelphia Limitorque Control gives absolute assurance against these dangers. Whenever undue resistance to the movement of the valve gate may be encountered Limitorque becomes operative, immediately disconnecting the motive power.

Philadelphia Limitorque Control is an efficient, mechanically operated device for opening and closing globe, gate, Penstock and rotary plug valves, as well as many other operations.

Limitorque is readily adapted to any make of valve. Furthermore, it can be installed on existing equipment.

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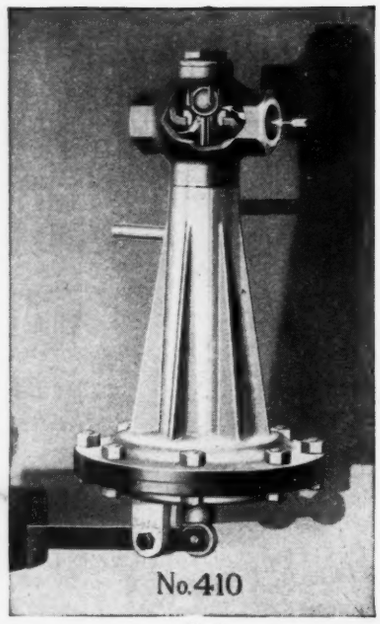
PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

ERIE AVENUE & "G" STREET, PHILADELPHIA, PA.



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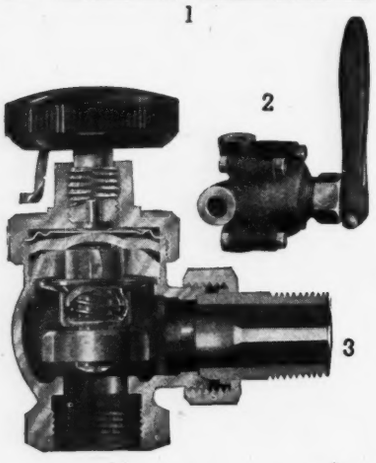

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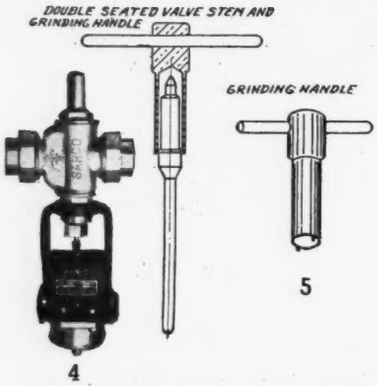

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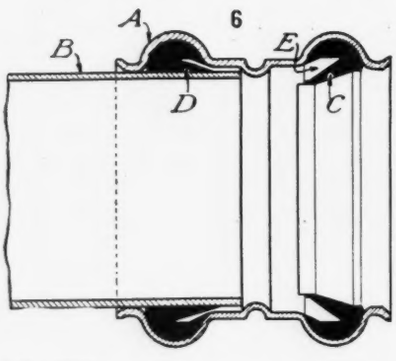

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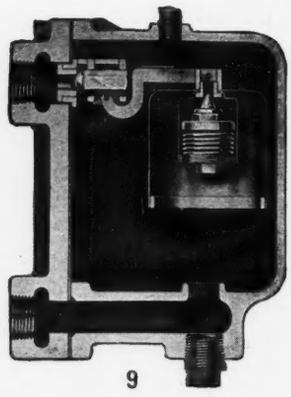


9

1 REDUCING VALVES — Ball-type, diaphragm-actuated reducing valves made in three models. No. 400, for pressures of 10 to 50 lb has interchangeable springs. Valve will operate in any position. No. 410 weight- and-lever type, for pressure from vacuum to 50 lb. Pressure is adjusted by changing weight on lever. No. 420, liquid-column type, for any reduced pressure provided sufficient height is available for liquid column. *Klipfel Mfg Co, 2641-59 W Harrison St, Chicago, Ill.*

2 AIR VALVE—Non-leaking control valve for single- and double-acting cylinders, air or oil to 125-lb pressure. Made in ¼-, ⅜-, ½- and ¾-in. sizes with flat bronze disks, protected seats, semi-steel bodies and seats. Full pipe are through ports may be throttled or open, as required. *W H Nicholon & Co, 213 Oregon St, Wilkes-Barre, Pa.*

3 PACKLESS VALVE — Multiplying levers magnify movement of diaphragm more than 3 times, give valve sufficient travel to make fine adjustments and eliminate bellows. No gaskets, stuffing boxes or packing. Cast-brass body with forged-brass bonnet and collars. *Trane Co, La-Crosse, Wis.*

4 HYDRAULIC MOTOR VALVES—For use with Sarco LS and L2S thermostats. A motor-driven vane pump builds up pressure in bellows chamber, compressing bellows, which operate valve pushrod. When thermostat opens electric circuit, valve returns automatically to closed position by spring pressure. Throttling or open-and-shut valve. *Sarco Co, Inc, 183 Madison Ave, New York, N. Y.*

5 VALVE-GRINDING HANDLE — For its "Vigilant" feedwater regulator, manufacturer has designed valve-grinding handle. Any wear on upper (steam) valve of double-seated valve stem is revealed by steady flow of steam from exhaust when counterweight is up. If cause is failure of valve to seat, it is corrected by turning screw on bridle arm. If steam still flows, valve is ground in. *Chaplin-Fulton Mfg Co, 28 Penn Ave, Pittsburgh, Pa.*

6 FLEXIBLE PIPE COUPLING—Coupler for plain-end pipes, permits substantial changes in alignment, and takes care of all expansion and contraction in pipeline. For water lines, gaskets are made of live rubber composition; for oil, gas and certain chemicals, gaskets are made from a duPont "Neoprene" compound. *R H Pierce Mfg Co, 245 Blair St, Eugene, Ore.*

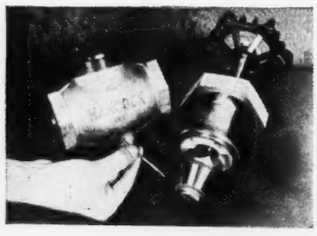
7 REDUCING VALVE—Forged-steel body, high-pressure reducing valve has formed packing of special material said to be immune to water, oil and other fluids. Pressure on seat is balanced by piston so that variations in high initial pressure have little effect on reduced pressure. *Atlas Valve Co, 2 82 South St, Newark, N. J.*

8 AUTOMATIC AIR ELIMINATOR — For venting driers, steam coils, traps, etc, under operating pressures up to 150 lb, nickel-plated bronze air eliminator has non-corrosive metal operating member which closes valve at 212 F and keeps it closed until temperature drops below boiling point. 2½-in. diameter, 4⅞-in. overal-all height, ½-in. bottom pipe connection. 3/16-in. diameter air outlet. *Gorton Heating Corp, Cranford, N. J.*

9 BUCKET TRAP—Completing line of float-thermostatic traps, this unit can be furnished with integral air bypass carried inside bucket consisting of balanced-pressure, thermostatic-trap element. Bypass said never to require setting and to operate satisfactorily regardless of pressure fluctuation. Sizes ½ to 2 in., with cast-iron bodies for 125-lb pressure, semi-steel to 250 lb, and cast-steel up to 500 lb. *Sarco Co, Inc, 183 Madison Ave, New York, N. Y.*

10 TILE CONDUIT—For underground steam and hot-water lines, "Adsco-Bannon" conduit is a base drain supporting a circular, salt-glazed, vitrified conduit with bell and spigot joints in approximately 2-ft lengths, separable in two halves along horizontal center line. *American District Steam Co, North Tonawanda, N. Y.*

GLOBE AND ANGLE VALVES—Completing a line of brone valves, 1¼-, 1½- and 2-in. sizes have hard, stainless-steel seats and disks. Valve trim is heat-treated to 500 Brinell. Illus-



tration shows a steel nail which makers state was crushed between seat and disk of 2-in. valve. *Hancock-Valve Div, Manning, Maxwell & Moore, Bridgeport, Conn.*

TROY-ENGBERG BY-PRODUCT POWER *Cuts Costs!*

STEAM ENGINES PROTECT

where fire or explosion might occur from sparking

This feature of the modern Troy-Engberg Steam Engine is only indirectly a cost-cutting item but it is highly important in such plants as oil refineries, gas and chemical plants where machinery is used to handle inflammable or explosive materials. Chances of sparking must be reduced to a minimum.

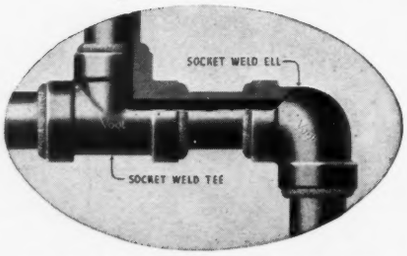
TROY-ENGBERG engines, powered by steam, do not spark. Even the leather governor belt can be replaced with enclosed chain running on bronze sprockets to eliminate any possibility of static. Power costs are just as low in other plants. Catalogue 305 gives full details. Send for a copy.

TROY ENGINE AND MACHINE CO.

1434 Railroad Ave. **Troy, Pa.**

Troy-Engberg Steam Engine driving a hot oil charging pump in the Shell Petroleum Corp., East Chicago refinery. Steam conditions: 130 lbs. pressure, 100° superheat, 0 to 12 lbs. back pressure. This Engine is equipped with variable eccentric. Write for data on other interesting Troy-Engberg installations.

OIL FREE EXHAUST • STEAM DOES DOUBLE DUTY • LOW MAINTAINED STEAM RATE • EASILY CONTROLLED WIDE FLEXIBLE SPEED RANGE • MANY APPLICATIONS • SUITABLE WIDE OPERATING CONDITIONS • MODERN DESIGN • LOW OIL CONSUMPTION • LITTLE ATTENTION • LOW MAINTENANCE • CONSERVATIVE SPEED • HIGH STARTING-RUNNING TORQUE • QUICK STARTING • NO EXPLOSION HAZARD • LONG LIFE • DEPENDABLE



DROP-FORGED WELD FITTINGS — Steel weld fittings have socket ends to receive pipe which insures alignment before and after welding. Socket construction said to keep weld "icicles" from forming in pipe or fitting. Whether standard, extra strong or double extra strong pipe is used, smooth passage through pipe and fittings is assured since fittings are bored to match inside pipe diameter. *Henry Vogt Machine Co, 10th and Ormsby Sts, Louisville, Ky.* (above)

PIPE UNION—"Dualsteel" union said to have great tensile strength (80,000 lb) and high resistance to corrosion. Completely "Parkerized", including threaded areas. Brinell hardness of 180. ¼- and 2-in. sizes. ***Rockwood*** *Sprinkler Co, 38 Harlow St, Worcester, Mass.*

PIPE FITTINGS—Eliminates cutting to exact lengths, threating, grooving, and flaring. Plain-end pipe is inserted into fitting, 2 threaded octagonal follower nuts are tightened, and gaskets at each end of fitting are compressed around pipe, forming positive seal. Resulting joint is permanently tight, absorbs vibration, expansion and contraction, and permits deflection of pipe. *S R Dresser Mfg Co, 718 Fisher Ave, Bradford, Pa.*

PUMPS

1 CENTRIFUGAL PUMP—Type SC "VorteX" single-suction pump for corrosive liquids made in a wide range of corrosion-resistant alloys and metals. Ball-bearing construction, deep stuffing boxes, and vertical split casing. *Lawrence Pump & Engine Co, Lawrence, Mass.*

2 MOTOR PUMP—2-stage motor pump, for heads up to 50 ft, consists of centrifugal pump, with enclosed bronze impellers, mounted on shaft of splash-proof motor. Two ball bearings take all radial and unbalanced thrust loads. Improved hydraulic design attained by placing first-stage unit next to motor and second stage on outside, simplifying crossover passage and placing stuffing box under suction instead of pressure. *Fairbanks, Morse & Co, 900 S Wabash Ave, Chicago, Ill.*

3 BOILER-FEED PUMP—Liquid end of unit, is of side-pot type. Rated for working pressure of 1000 lb per sq in. Individual openings over each valve, making them easily accessible. Steam valves are designed for 350-lb pressure. All pressure joints have been eliminated by casting steam cylinders and chest integrally. *Worthington Pump & Machinery Corp, Harrison, N. J.*

4 PORTABLE ROTARY PUMP — V-belt drive from motor to pump is completely enclosed by removable guard. Silent-chain drive if desired. Can be ordered without casters for permanent installation. Two sizes, 10 and 20 gpm. Positive in displacement; designed for high-suction lifts; needs no priming. *Blackmer Pump Co, Grand Rapids, Mich.*

5 CENTRIFUGAL WELL PUMP—Vertical, close-coupled, motor-driven centrifugal pump for deep or shallow wells has no mechanical moving parts below ground. Units for shallow-well service consist of combined motor, pump and base, into bottom of which is screwed single suction pipe. Pumps for deep wells have ejector and venturi. *Fairbanks, Morse & Co, 900 S Wabash Ave, Chicago, Ill.*

6 BOILER-FEED PUMP—"Doubleton" has double suction impellers and double balance of rotating element. Horizontally split casings for pressures 1500 lb and above, with high-temperature bolting to maintain tight joint. Can be used for other high-pressure service than boiler feeding. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

7 MOTOR-MOUNTED PUMP—For capacities of 5 to 1200 gpm and heads of 10 to 230 ft. Pump is mounted on end bell of electric motor, two forming self-contained unit with one shaft and two bearings. Cast-iron pump casing. Impeller, wearing ring, shaft sleeve, stuffing-box gland and lantern ring of bronze. *De Laval Steam Turbine Co, Trenton, N. J.*

8 SELF-PRIMING CENTRIFUGAL PUMP —"Sure Flow" centrifugal pump is self priming and instant flowing. No metal to metal contact; bearing surfaces protected by rotary seals. Made in nine models, ranging in capacity from 4 to 150 gpm, and with direct motor drive, belt drive, or adapter for direct power takeoff. *Logansport Machine Co, Inc, Logansport, Ind.*

CENTRIFUGAL COOLANT PUMP—Impeller, open, double-suction type, hydraullicaly balanced to eliminate end thrust, is mounted directly on large-diameter extended motor shaft. Pump casing is cast integral with motor support. Built only in ¾-in. size for circulation of coolants, cutting compounds, or similar liquids. Capacities up to 30 gpm. *Goulds Pumps, Inc, Seneca Falls, N. Y.*

CENTRIFUGAL PUMP—Type CF pumps, for belt or motor drive, are single-stage centrifugal units in capacities of 10 to 300 gpm at heads from 10 to 120 ft. Two grease-lubricated ball bearings are standard. New YU type pressed-steel frame. *Worthington Pump & Machinery Corp, Harrison, N. J.*

CLOSE-COUPLED PUMPS — Splashproof, direct-mounted pumping units are designed for severe conditions. Self-adjusting rotary seal takes place of usual stuffing box. Wearing rings are renewable for both impeller and casing. Motors are furnished either splash-proof or standard construction. *Columbus Steam Pump Works Co, 724 Broderick St, Columbus, O.*

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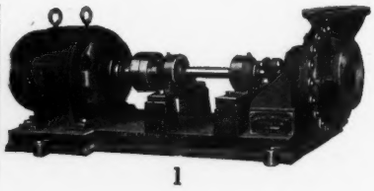

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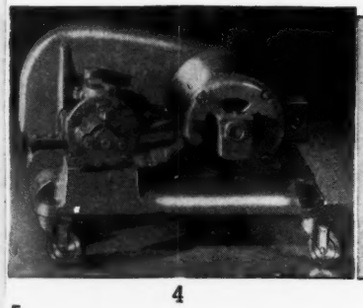

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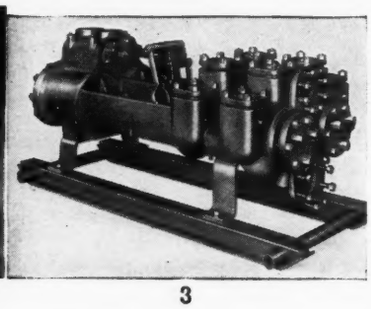

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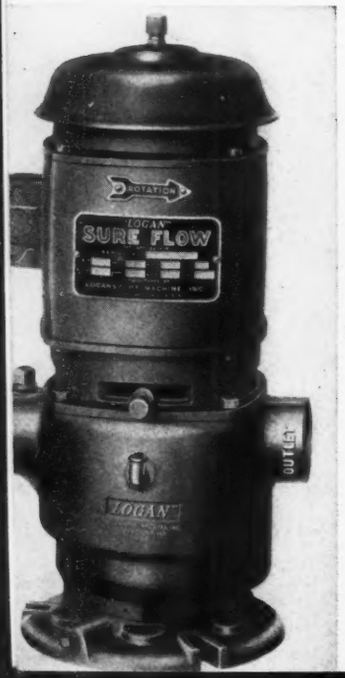

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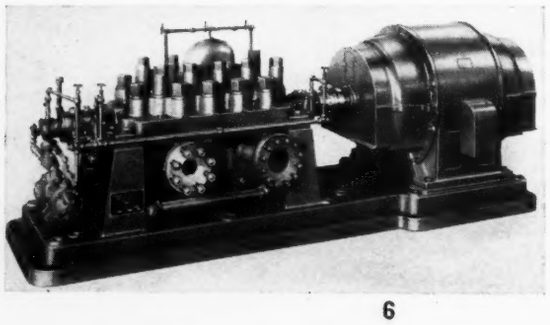

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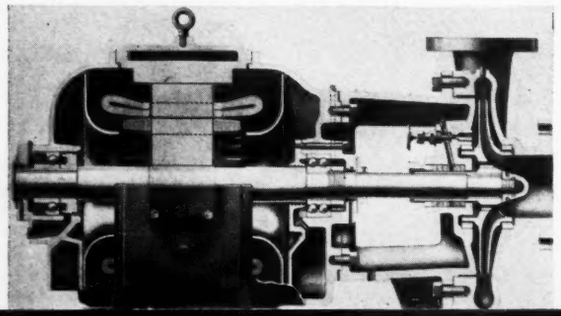


INCREASE
YOUR PROFITS
WITH
J&L
STEEL
J&L Seamless is pierced, expanded, and rolled . . . for extra toughness, density, and accurate wall thickness.

Making a power piping bend of J&L Seamless Pipe.

There's extra strength in every length of J&L Seamless Pipe

. . . it costs less in the long run

J & L Seamless Pipe has no weak spots where rupture or failure can start. There can be no failure at or near a weld . . . for there are no welds. Thus J&L Seamless is safe . . . lasts a long time even in severe service . . . and is more economical than less satisfactory piping.

The J&L piercing and rolling process improves grain structure, density, and ductility . . . literally rolls extra life and extra strength into every length. High quality is assured by strict metallurgical control over every manufacturing process, from ore mines to finished product. Installations in power and process plants all over the country are proving the safety and economy of J&L Seamless.

Make your maintenance dollars go farther . . . with the extra advantages, the longer life, the greater safety of J & L Seamless. Specify Jones & Laughlin for all your power and process needs.

JONES & LAUGHLIN STEEL CORPORATION

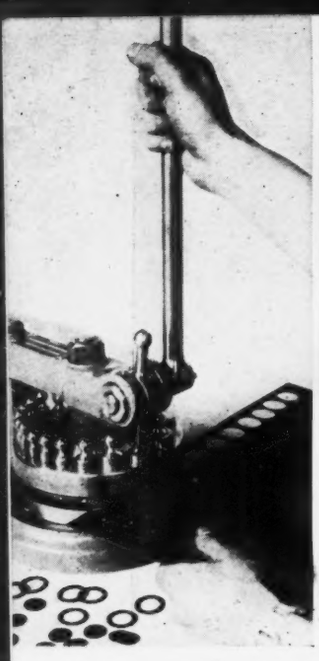
PITTSBURGH, PENNSYLVANIA

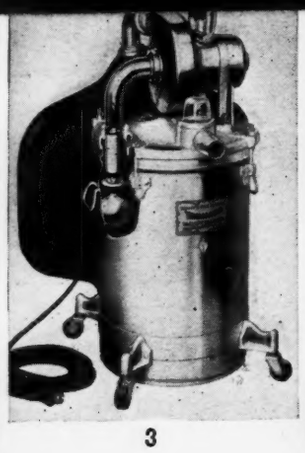
MAKERS OF HIGH QUALITY IRON AND STEEL PRODUCTS SINCE 1850

Other J&L Products

Seamless Boiler Tubes . . . Seamless Condenser and Heat Exchanger Tubes . . . Welded Steel Pipe . . . and a variety of other steel products for maintenance and manufacturing.

Write for this J&L Tubular Pipe Handbook—SP-3, on your business letterhead. It contains valuable application data, including a steam flow chart, that will help you.





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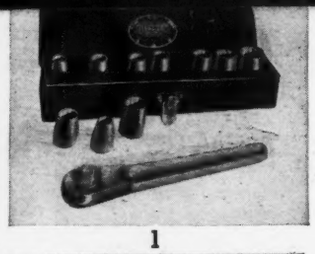

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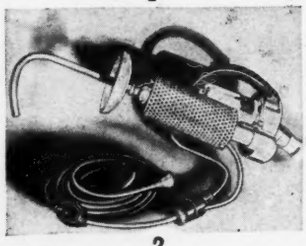

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WRENCHES AND OTHER TOOLS

1 SOCKET SETS—Chrome-vanadium steel, chromium plated, with heads buffed. Two sets, No. D with 10 sockets for ½-in. square drive and ratchet handle with lug, and No. D-1, identical to No. D except for a 15-in. hinge handle. *Bonney Forge & Tool Works, Allentown, Pa.*

2 ELECTRIC HEAT GUN—Combines 1000-watt electric heating unit and a hand vacuum cleaner, which provides large volume of warm air. Bell-shaped shield prevents grease from dripping on heater, further protected by heavy screen guard. Air circulation provided by air-cooled, ball-bearing, 110-volt, ac-dc motor. *General Electric Co, Schenectady, N. Y.*

3 CLEANING EQUIPMENT—Improved industrial vacuum cleaner and portable electric blower removes dust and dirt from motors, machinery. Enclosed ball-bearing assembly and screen over end of motor housing. *Bruer Electric Mfg Co, Chicago, Ill.*

4 HEAVY-DUTY WRENCHES—Heavy-pattern wrenches have heads of approximately same thickness as nuts they serve. Openings range from 1¼ to ⅜ in. Dropforged in two lines; carbon steel and chrome-molybdenum. *J H Williams & Co, 75 Spring St, New York.*

5 COMBINATION ELECTRIC HAMMER AND DRILL—Improved tool has new retainer made of molded rubber, which fits over nose of hammer and holds cutting tool in place with right amount of play for rapid drilling or cutting. Also keeps grit from getting into socket in overhead drilling. *Wodak Electric Tool Corp, 4627 W Huron St, Chicago.*

6 WASHER PUNCH—18-die punch (size range of ⅛ to 1⅜ in.) for fibre, steam packing, asbestos, leather, felt, cork, etc, up to 1/16 in. in thickness. Dies mounted in eccentric turret plate. Centering system insures concentric punching. *Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.*

ALLOY-STEEL WRENCHES — Heavy-duty, drop-forged, alloy-steel, box-socket wrenches made in straight, offset and angle types with openings from 1¼ to 3½ in. Tubular extensions provided to slip over forged handle and permit leverages up to 30 to 1. *Armstrong Bros Tool Co, Chicago, Ill.*

WELDING

7 METAL-SPRAY GUN—Improved "Majestic MetalayeR" deposits approximately 100% more metal in a given time with about 1/3 less oxygen and acetylene consumption per weight of metal deposited on larger size wires. *Metals Coating Co of America, 495 N 3rd St, Philadelphia, Pa.*

8 MIDGET AC WELDERS—Current range of 30 to 140 amp with 12 steps of current adjustment for coated electrodes from 1/16- to 5/32-in. diameter. 60-cycle set weighs 112 lb, 50-cycle set 130 lb. Operating efficiency of 87% at normal loads. *Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.*

9 METAL-SPRAY GUN—Will handle wire from 0.032 to 0.125 in. Single Monel and bronze valve controls flow of acetylene, oxygen and air simultaneously. All ball bearings, gears and worms lubricated from one point. Handles metals melting up to 4800 F. *Metalspray Co, Inc, 113 Lewellyn St, Los Angeles.*

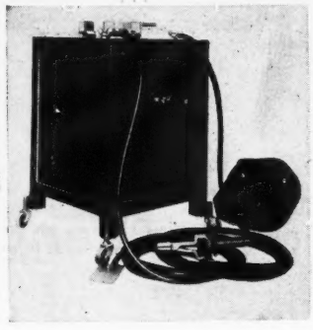
10 METAL-SPRAY GUN — Integral gear shift gives high speeds for low-melting-point metals, low speeds for spraying aluminum, copper and all steels. 2-piece high-capacity nozzle has positive tapered seats without threads. *Stevens Metal Spraying Inc, San Francisco, Calif.*

11 OXYGEN REGULATOR — "Prest-O-Weld" Type R112 oxygen regulator designed for general cutting duty. Refinements in design give greater accuracy and sensitivity in operation. Unit has 400-lb delivery pressure gage. *Linde Air Products Co, 205 E 42nd St, New York, N. Y.*

12 PORTABLE ARC WELDER—Transformer-type welder in four models with capacities from 130 to 300 amp. Has rotary knife-switch control with amperage marked for each welding step. *Miller Electric Mfg Co, Appleton, Wis.*

SEAM WELDER — Ignition tubes eliminate power contactors and transformers. Inductive timer, a synchronous-driven disk rotating once per sec and containing 120 holes, each corresponding to a half cycle of welding current, times power impulses to a wheel electrode. *Westinghouse Electric & Mfg Co, Pittsburgh.*

WELDING ELECTRODES — "Fleetwood 8" electrode eliminates necessity of multiple-pass welding in production of fillet and lap welds and permits production of such welds without undercutting or overlap. *Lincoln Electric Co, Cleveland, Ohio.*



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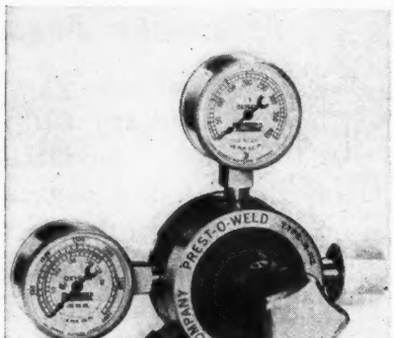

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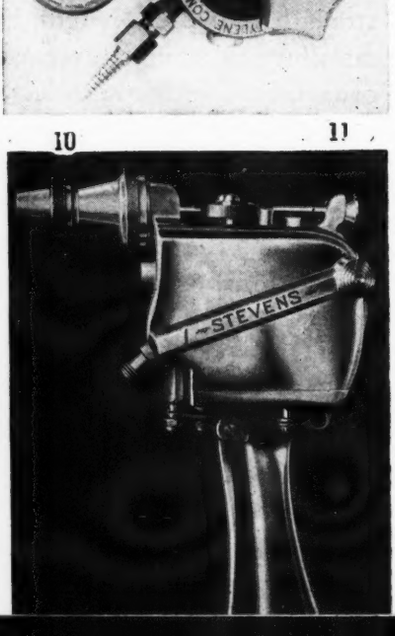

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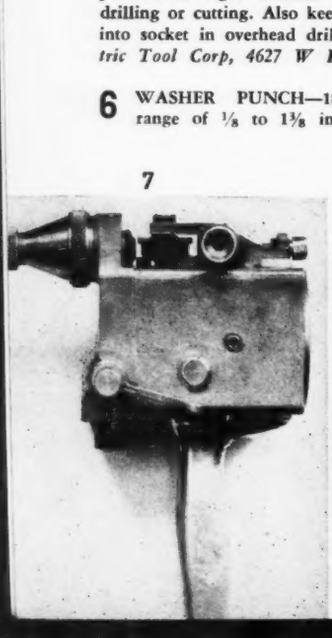

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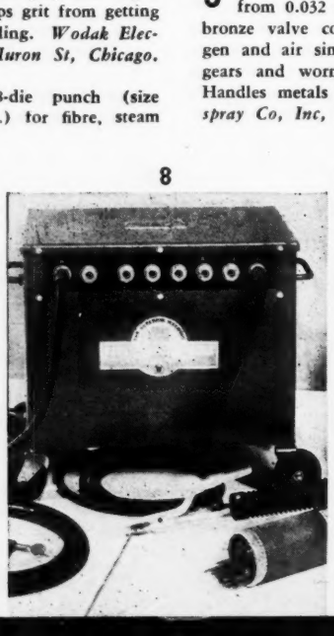

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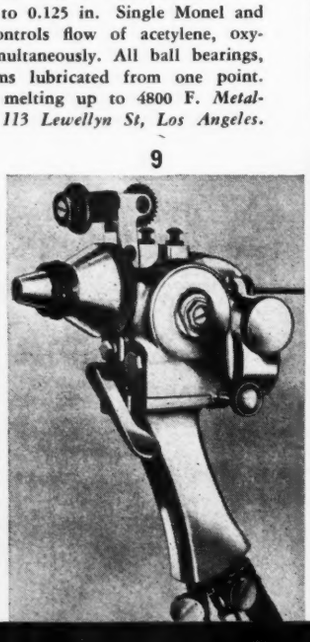


OK BIG BOY
YOU'RE A CRANE VALVE

BEFORE a valve can join the Crane line, it has to prove that it is worthy of the name. It must prove that its design and material give it extra strength in every part. It must meet and beat the most exacting official standards of industry for the services for which it is intended.

It must prove that it stands up on the job.

Then, and only then, is a valve considered good enough to be welcomed into the Crane line. Then, and only then, does Crane say, "O. K., big boy, you're a regular Crane Valve!"

The Crane valve and fitting line is the largest in the world. Crane has the answer to most "new" valve problems—solutions developed during 82 years of valve-building experience. Look in your Crane No. 52 Catalog for the details regarding 38,000 items, tested in the laboratory and proved on the job. Use it whenever you need valves, fittings, pipe or accessories. CranEquip for satisfaction.

CRANE

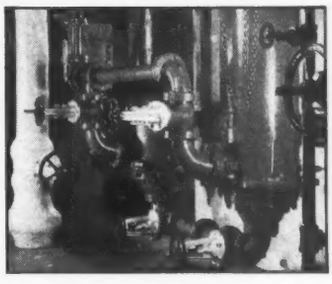
CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, PLUMBING AND HEATING MATERIAL

plied in the next few days.

REVEALS MAJOR FACTORS OF VALVE SELECTION



NEW YORK CITY, Nov. 12—Choose gate valves for services where unrestricted flow is commonly needed, or where valves remain wide open or fully closed for long periods. The Crane Iron Body Gate Valves described on Pages 67 to 138 of the Crane Catalog are typical of the best types of such valves.

Use conventional type globe valves where slight resistances to flow are permissible, but *not* where valves are used for throttling. Very popular examples of such valves are the Crane No. 7 globe and angle valves shown on Page 16 of the Crane Catalog.

The most practical commercial valve for throttling is a well-designed plug disc globe valve with the proper seating metals for the particular service. The Crane 300-Pound Brass Globe and Angle Valves illustrated and described on Page 24 of the Crane No. 52 Catalog are excellent examples of this type of valve.

Once the major type of valve is decided upon with proper relation to the above factors, the engineer or operator has a great variety of choice of sizes, body and seat metals, strengths, etc., as will be seen by even a brief glance through your Crane Catalog. However, many refinements of choice are best made after consultation with Crane engineers. They are constantly in touch with the results of valve operation in thousands of different services and their recommendations are based on the results of both laboratory testing and field service. Consult them about your problems.

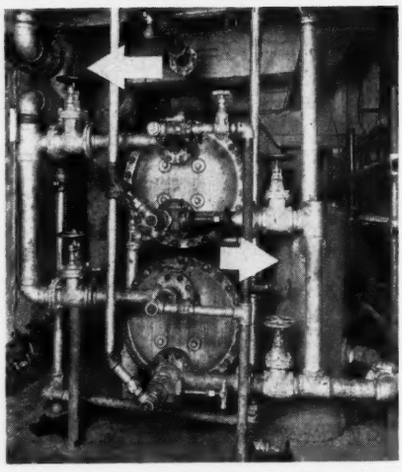
KIRKALDY SYSTEM

Non-Chemical

Eliminates Scale, Corrosion and Slime

in Boilers, Economizers, Heaters, Condensers, etc.

Boilers and heaters badly scaled, even with the heaviest calcium and silica deposits, are quickly cleaned and kept in efficient operating condition by the Kirkaldy System. Condensers suffering from slime and algae deposits are just as definitely protected. As long as the System continues in operation neither scale nor slime can accumulate on the surfaces protected, nor can CORROSION take place.



Installation of Kirkaldy System recently made in the Power Plant of a prominent Eastern Milk Company.

The Kirkaldy System is the only practical and economical method of achieving both these results. *Write for Bulletin No. PB 37-2.*

ELECTROLYTIC METAL PROTECTION INC.

247 PARK AVENUE NEW YORK, N. Y.

FORGED STEEL

Socket End

WELDING FITTINGS

Forged for strength, accurately machined and tested to double their rated pressure.

That's why W-S Welding Fittings give extra long service life. That's why they are more dependable.

Installations in power and process plants on high pressure, high temperature pipe lines are proving the safety and economy of W-S Fittings.

Write for Bulletin A-3.

THE WATSON-STILLMAN CO.

ROSELLE, N. J.

POWER LINES

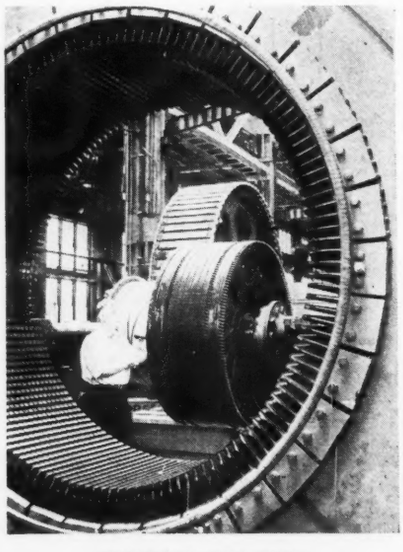
Canadian Hydro Plant

A contract has been awarded the Standard Construction Co Ltd, 736 Granville St, Vancouver, B. C., for the installation of a hydro plant to supply power to the gold dredge of the Fraser River Golds Ltd, Jones Creek B. C. The contract involves outlay of $50,000 for construction of a dam on Jones Creek, three quarters of a mile of pipeline, power house and transmission line.

About one quarter of a mile of wood-stave pipe and half a mile of steel pipe will be required to provide a head of about 370 ft. of water to operate the turbine-generators. The new generators will develop 1500 hp, although the dredge requires only 1250 hp for capacity operation. Half a mile of high-tension line will be erected to handle transmission of electrical energy from the power house on Jones Creek to the dredge anchored at an island in the Fraser River.

Discussion on Coal Selection

The problem of coal selection and the steps being taken by the coal industry to simplify it was the general subject of a meeting held recently by the Metropolitan Section, Fuel and Power divisions of the A S M E. Dr R A Sherman spoke of the extensive researches being carried on by Bituminous Coal Research Inc, a fact-finding organization sponsored by the coal producers. C A Reed of the National Coal association and J E Tobey of Appalachian Coals Inc dis-



THROUGH THE FIELD

Workman lines up the leads of a large dc armature in the Schenectady Works of the General Electric Co as the cameraman uses a large field structure as a picture frame

IMPREGNABLE!

In the Allis-Chalmers Seal-Clad Motor the wound stator receives impregnating treatment, similar to the conventional type of winding. Then a Moulded Shield of high dielectric and mechanical strength is fitted into a machined slot in the stator frame and tightly sealed into position with a special compound—thus giving complete protection to the coils.

This feature makes Allis-Chalmers Seal-Clad Motors impregnable to metallic dust, grit, oil, moisture, chemicals and other agents destructive to motor windings.

One or more of these destructive agents are present in every plant, to a greater or lesser degree . . . so why take a chance?

If your plant conditions are severe, the ultimate in motor protection is essential to you—Allis-Chalmers Seal-Clad Motors offer the ultimate in motor protection. If your plant conditions are not so severe as to make this protection absolutely essential, Allis-Chalmers Seal-Clad Motors are still the soundest investment you can make, BECAUSE YOU ARE GIVEN THIS GREAT ADDITIONAL PROTECTION AT NO ADDITIONAL COST.

For further details, write today for Leaflet No. 2182.

The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

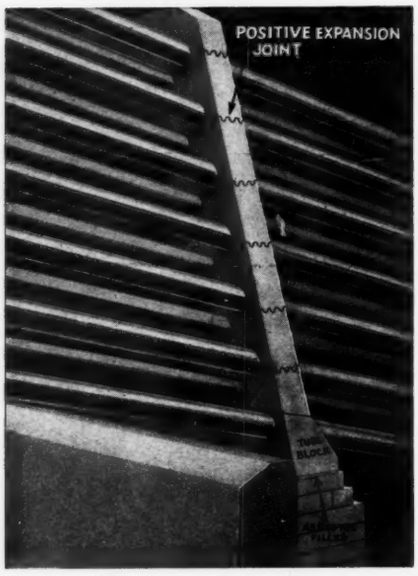
794

MOTOR DIVISION

ALLIS-CHALMERS

MILWAUKEE WISCONSIN

BECO-TURNER BAFFLES



The baffles with EXPANSION JOINTS

THE famous Beco-Turner baffles are distinguished by their patented expansion joints which keep them gas tight throughout their entire life. You can install Beco-Turner baffles—*and forget them.*

These unique expansion joints give the Beco-Turner baffle unrivalled flexibility. They allow free movement at all times under the forces of expansion and contraction, preventing the cracks that develop in ordinary monolithic baffles. Furthermore, these expansion joints make possible the easy removal and replacement of warped boiler tubes with a minimum of damage to the baffle.

Beco-Turner baffles can be installed at any angle necessary to bring about the most efficient heat transfer to the boiler tubes. They improve efficiency and increase capacity The average Beco-Turner installation effects a fuel saving of at least 3%. Every installation is a tailor-made job, designed to fit the boiler.

Why not investigate the possibility of saving fuel through more advanced baffle design? Upon receipt of blueprints showing your present baffles, our engineering department will be glad to give you any possible recommendations for improving the operation of your boilers through improved baffle design. No obligation.

PLIBRICO JOINTLESS FIREBRICK CO.

Baffle Dept., Chicago, Ill.

MAIL COUPON FOR FREE CATALOG

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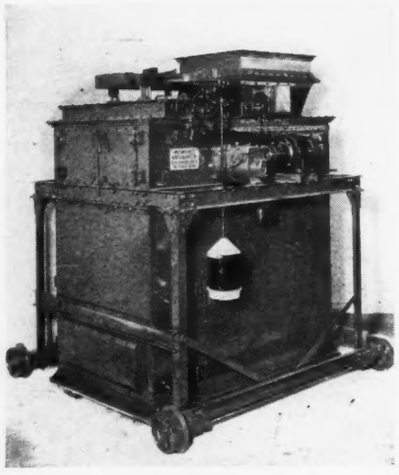
Send blueprints and our engineering department will suggest any possible recommendations for improving your baffle design. P14-37



WILLIAMSBURG'S SCALES

One of six Richardson automatic coal scales, each having a capacity of 18 tons per hr, installed by Brooklyn & Manhattan Transit Co for its Williamsburg generating plant. These units weigh and automatically record coal supplied to six pulverizers serving two 600,000-lb-per-hr B & W boilers. Each scale weighs about 3600 lb and has a hopper capacity of 400 lb

cussed some of the reasons why coal selection is difficult and suggested steps for improving the situation. All speakers agreed that the coal industry must devise some method whereby the small coal buyer can be assured of getting coal that fits his needs. By eliminating costly selling methods and equally costly complaints and investigations, this program will enable the industry to reduce prices and operate on a more satisfactory basis.

PERSONALS

C F CATE, 234 N Davis St, El Paso, Texas, has been appointed agent for Roller-Smith Co, New York, N. Y., for southwestern Texas and southern New Mexico.

ROBERT BISCHOFF, formerly associated with the manufacture of hydraulic turbines in Switzerland, has been placed in charge of all valve engineering for Koppers Co's Western Gas Div, Fort Wayne, Ind. This division manufactures hydraulic gates and special valves, as well as gate valves for water works, sewage plants, and processing industries.

E G BAILEY, vice-president of Babcock & Wilcox Co, New York, N. Y., and president of Bailey Meter Co., Cleveland, Ohio, was awarded the honorary degree of Doctor of Engineering by Lehigh University at its Founders' Day exercises at Bethlehem, Pa., Oct 6. The award was made for "notable and distinguished accomplishment in the field of combustion and steam engineering."

DAVID M HARVEY has been appointed superintendent of the Oil Dept at the Philadelphia plant of E F Houghton & Co. Prior to his present appointment, Mr Harvey spent six years at the Houghton plant in Manchester, England.

INSTRUMENTS *for* MEASURING SPEEDS

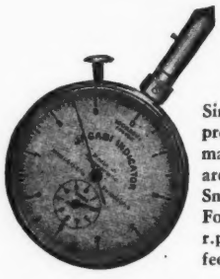
Instruments with which to indicate r.p.m. and surface speeds of *all* types of machinery are essential equipment . . . should be on hand for instant use. We offer an attractive selection of such devices for special as well as routine requirements. Ranges—from as low as 30 up to 100,000 r.p.m. High quality, accurate, dependable.

"FRAHM" TACHOMETERS

for measuring speeds up to 30,000 r.p.m. of motors, generators, turbines, centrifuges, etc. Also indicate impulses per minute in air tools, vibrators, etc. Contain no rotating parts. Indicate by vibration of tuned steel reeds. Simply place on machine. No direct contact with rotating part. Nothing to wear out. Hand and permanent mounting types. Bulletin 1510-P.

"JAGABI" SPEED INDICATOR

(Chronometric Type)



A "vest-pocket tachometer". Measures average r.p.m. or feet per minute without any calculations. Simply insert tip and press a button. Automatic. Measured speeds are read at leisure. Small size. Low price. For speeds up to 20,000 r.p.m. and up to 10,000 feet per minute.

"JAGABI" HAND TACHOMETERS

(Centrifugal Type)

Measure rotating speeds directly in revolutions per minute. Measure linear and peripheral speeds directly in feet per minute. Also show speed variations. Exceptionally well made, having scales 6¼" long. Carefully balanced. Accurate. Unaffected by temperature variations or position. Various ranges up to 40,000 r.p.m.

The above instruments, as well as a Hand Tachograph for recording speeds, a Tachonorm or Per Cent Tachometer and other highly developed speed indicators are illustrated and described in Bulletin 1505-P. Ask for a copy.

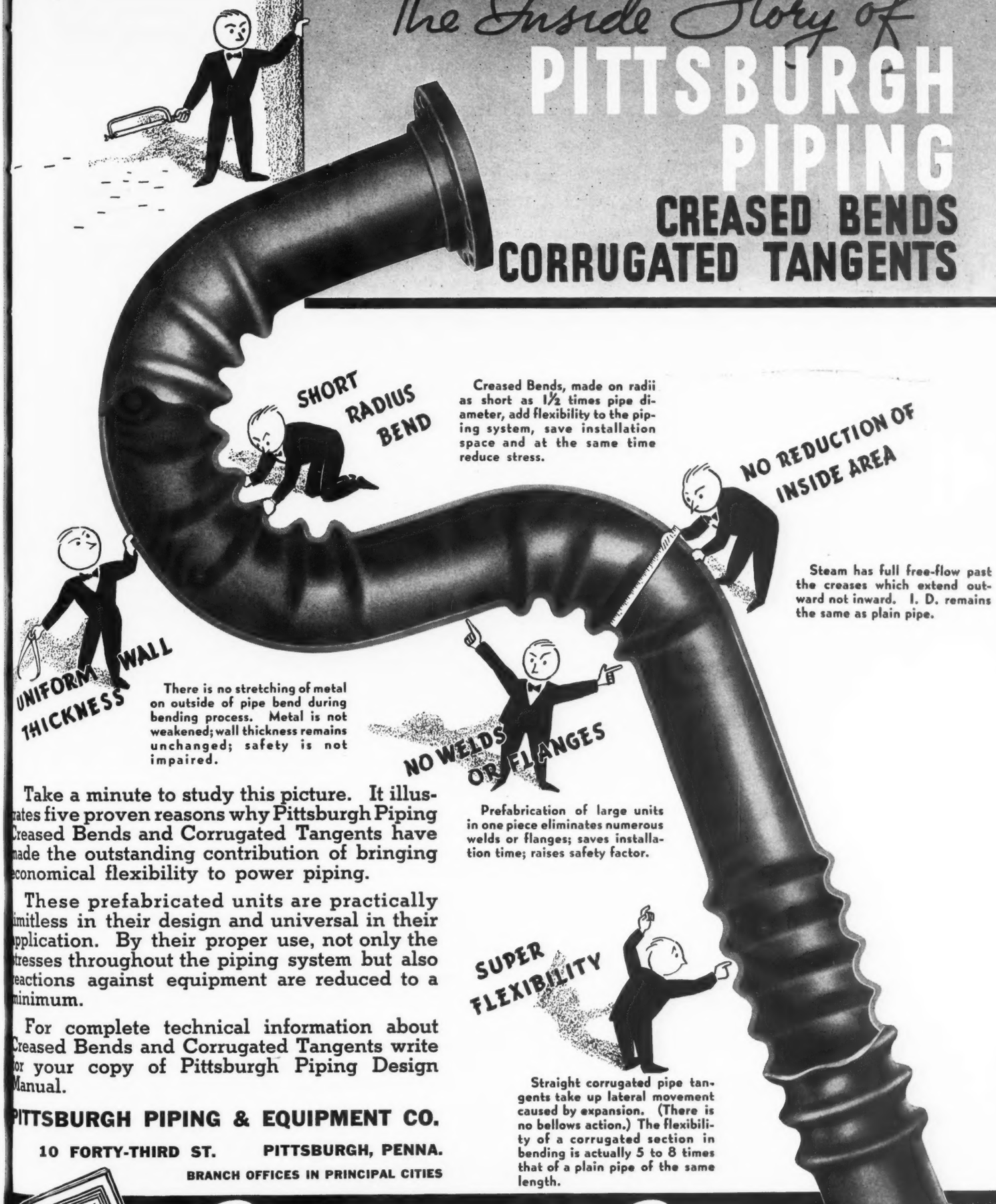
JAMES G. BIDDLE CO.

ELECTRICAL AND SCIENTIFIC INSTRUMENTS

1211-13 ARCH STREET, PHILADELPHIA, PA.

The Inside Story of PITTSBURGH PIPING

CREASED BENDS CORRUGATED TANGENTS



SHORT RADIUS BEND

Creased Bends, made on radii as short as 1½ times pipe diameter, add flexibility to the piping system, save installation space and at the same time reduce stress.

NO REDUCTION OF INSIDE AREA

Steam has full free-flow past the creases which extend outward not inward. I. D. remains the same as plain pipe.

UNIFORM WALL THICKNESS

There is no stretching of metal on outside of pipe bend during bending process. Metal is not weakened; wall thickness remains unchanged; safety is not impaired.

NO WELDS OR FLANGES

Prefabrication of large units in one piece eliminates numerous welds or flanges; saves installation time; raises safety factor.

SUPER FLEXIBILITY

Straight corrugated pipe tangents take up lateral movement caused by expansion. (There is no bellows action.) The flexibility of a corrugated section in bending is actually 5 to 8 times that of a plain pipe of the same length.

Take a minute to study this picture. It illustrates five proven reasons why Pittsburgh Piping Creased Bends and Corrugated Tangents have made the outstanding contribution of bringing economical flexibility to power piping.

These prefabricated units are practically limitless in their design and universal in their application. By their proper use, not only the stresses throughout the piping system but also reactions against equipment are reduced to a minimum.

For complete technical information about Creased Bends and Corrugated Tangents write for your copy of Pittsburgh Piping Design Manual.

PITTSBURGH PIPING & EQUIPMENT CO.

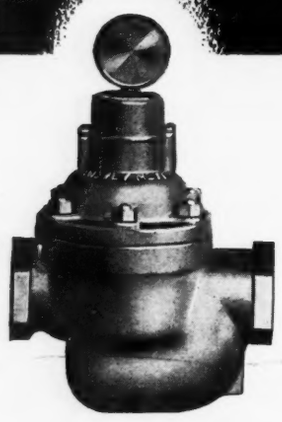
10 FORTY-THIRD ST. PITTSBURGH, PENNA.

BRANCH OFFICES IN PRINCIPAL CITIES

Pittsburgh Piping

CREASED BENDS • CORRUGATED TANGENTS

This HENSZEY METER



is what

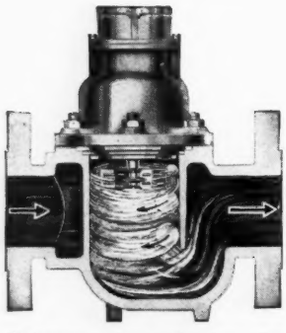
YOU NEED

to measure

your **BOILER FEED WATER** *and* **BLOWDOWN**

This meter operates within 2% of absolute accuracy regardless of heat or dirt in the water. It also measures the pulsating flow of reciprocating pump.

Send in the coupon below for complete information



Cutaway view showing the rotating valve in the measuring chamber.

HENSZEY

HENSZEY COMPANY
Dept. D 12, Watertown, Wis.
Please send further information

Name .....

Firm .....

Address .....

E M DONOHUE has been appointed representative of Fedders Mfg Co, Buffalo, N. Y., to serve in Cleveland, Ohio.

ARTHUR LOOS, former sales engineer with Iron & Steel Products, Inc, has been made manager in charge of buying and selling industrial machinery for the Triangle Engineering Co, 53 W Jackson Blvd, Chicago, Ill.

WERNER J WESTPHALEN, vice-president and general manager of Lacledé-Christy Clay Products Co, St Louis, Mo., was elected president of the American Refractories Institute at its October meeting in Colorado Springs, Colo.

ARTHUR T COX, JR, has been appointed manager of Lincoln Electric Co's Tri-Cities office, Moline, Ill. He succeeds J B Flock, who is taking a years leave of absence.

OLIVER F ALLEN, consulting engineer, has severed connections with the PWA in New York, N. Y., in order to devote more time to his private consulting practice on diesels, power plants and international engineering.

FRANK PIATT, former president of the American Refractories Institute, has accepted a position as vice-president of Mexico Refractories Co, Mexico, Mo. Mr Piatt was for several years sales manager for an eastern firebrick company prior to his appointment as Refractories Institute president.

A P LIVAR has been appointed chief engineer in charge of heating design for Airtemp, Inc, air-conditioning subsidiary of Chrysler Corp, Dayton, Ohio. Mr Livar was formerly with Reynolds Corp as manager of the Air-Conditioning Div. Prior to that he was vice-president in charge of sales and manufacturing for Richmond Radiator Co, Inc, where he designed the "Richvar" cast-iron convector radiator and boiler.

BUSINESS ITEMS

NORTHERN EQUIPMENT Co, Erie, Pa., has appointed Cochrane Steam Specialty Co, Boston, Mass, as New England representative for sales and services of Copes feedwater regulators, differential valves, pump governors, reducing valves, desuperheaters, etc.

GENERAL CONTROLS Co has opened a new branch office in Chicago at 450 East Ohio St, under the management of H G Wasserlein.

HOMESTEAD VALVE MFG Co, Coraopolis, Pa., has appointed the following new representatives: Gibson Co, Indianapolis, Ind.; Keys Co, East Liverpool, Ohio; Minneapolis Iron Stores Co, Minneapolis, Minn.; Dye Motor Supply, Akron, Ohio; and Canton Hardware Co, Canton, Ohio.

TERRY STEAM TURBINE Co, Hartford, Conn., recently appointed the following new representatives: C F Cate, El Paso, Texas; Darby Corp, Kansas City, Kan.; and Ray F Riddle, Tulsa, Okla.

"PBH" Vertical Water Gauges

Quick-Closing

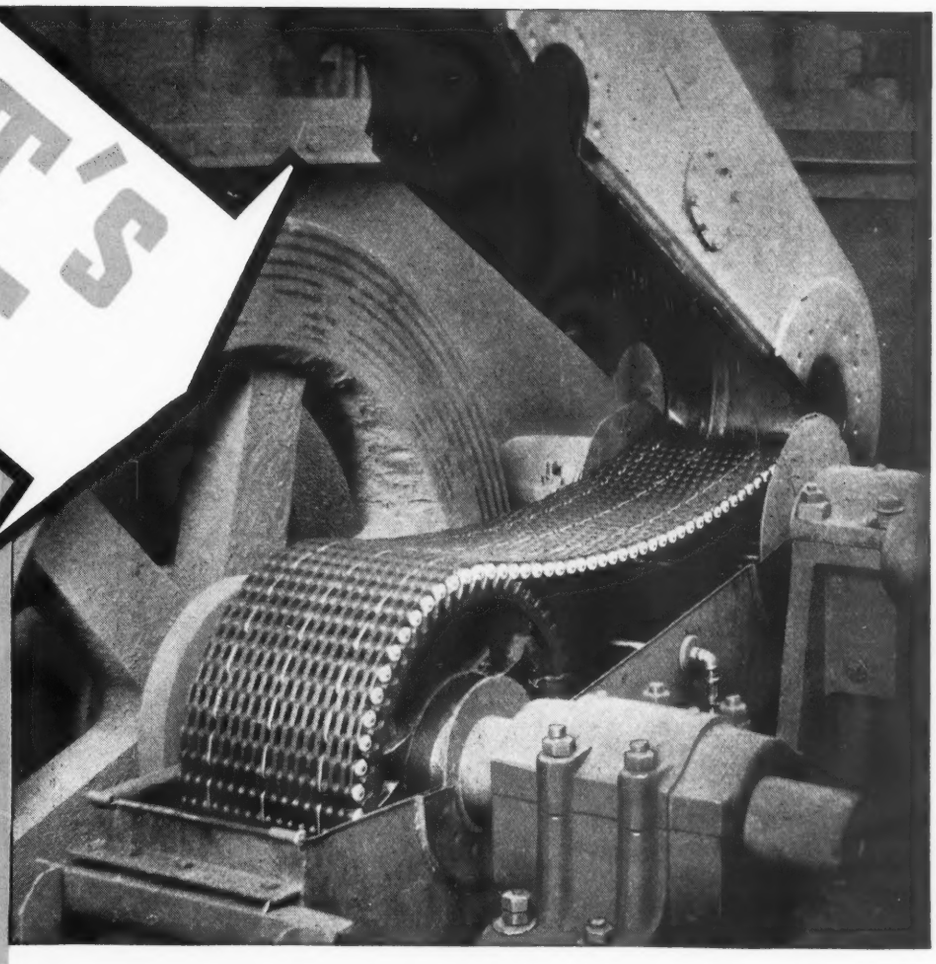
Opened or shut by less than a quarter-turn. When a glass breaks, the gauge is shut off by a pull of the chain. No scalds; no burns. Steam and water passages are ample and have no "pockets" to collect sediment. Body is extra heavy and of best steam metal. All valve stems packed with asbestos graphite rings—nuts are large to accommodate ample size rubber washers. All Double Extra Heavy water gauges have monel metal seats and valve stem loose discs. All extra heavy water gauges have monel metal loose disc valve stem tips. All gauges can be equipped with an attachment which shuts off both water and steam automatically should the gauge glass accidentally break.

For the complete PBH line of Power Plant Equipment and Instruments, write today for catalog A34.

The PAUL B. HUYETTE CO., Inc.
Est. 1896
401 N. Broad St., Philadelphia, Pa.

IT'S TRUE

Even in FIRST COST SILENT CHAIN DRIVES ARE OFTEN Lower than Belts



● Some plant executives have the idea that silent chain drives are expensive. Actually they cost less... even their first cost being lower than belts in many instances. Over a period of years, Link-Belt Silverstreak Silent Chain Drives always show important savings because they are built to give constantly efficient service with practically no attention or upkeep expense. They transmit full speed and power... never slip . . . save space . . . and are smooth and quiet in operation. Cut your production costs . . . save maintenance trouble and expense by equipping your machines with Silverstreak Silent Chain Drives.

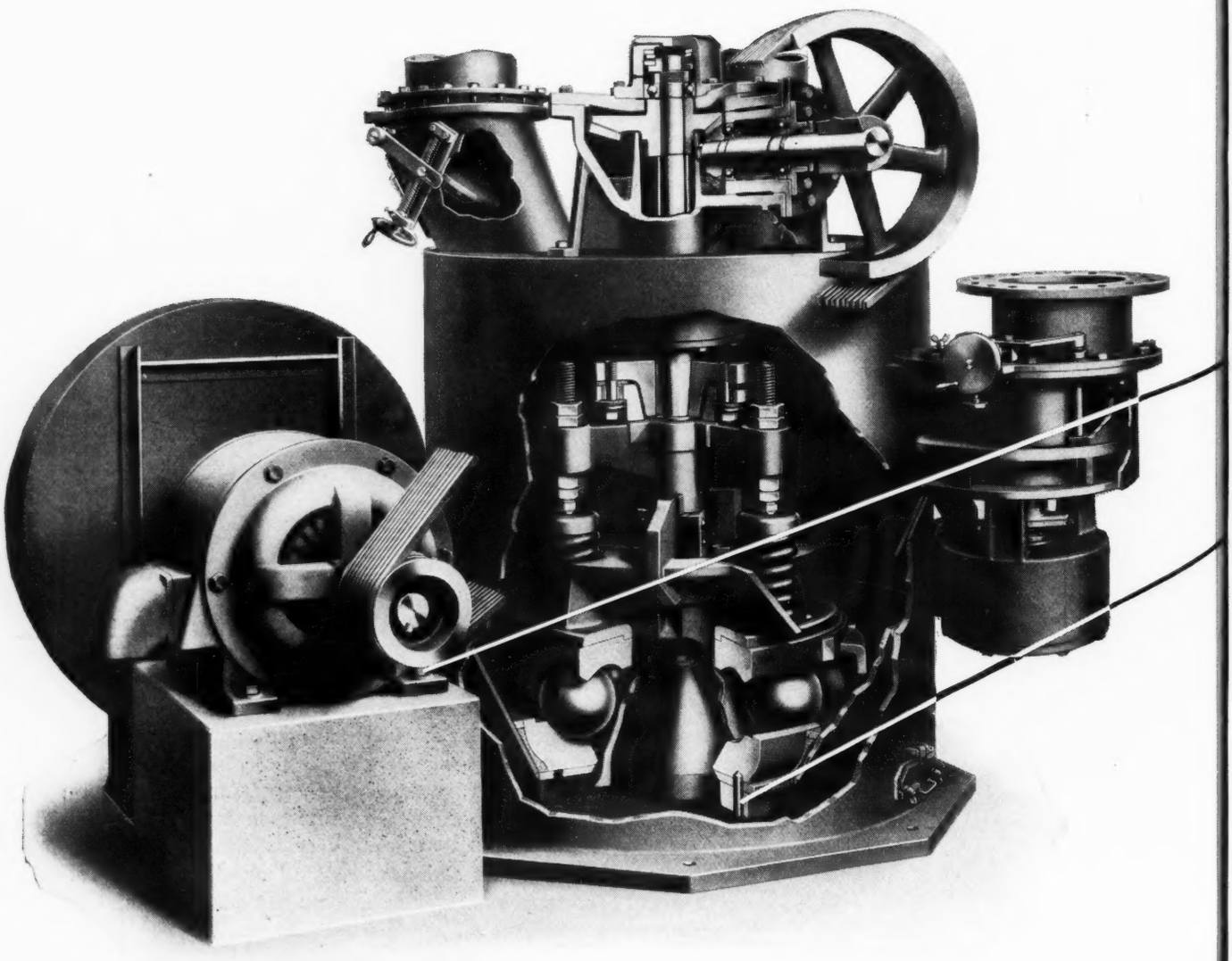
Send for data book No. 125. Also send for catalogs covering roller chain drives, speed reducers, variable speed transmissions, and the complete line of transmission units such as anti-friction and babbitted bearing pillow blocks, clutches, couplings, take-ups, pulleys, gears, etc.

Link-Belt Company, Indianapolis, Chicago, Philadelphia, Atlanta, San Francisco, Toronto, or any of our offices located in principal cities. 7159

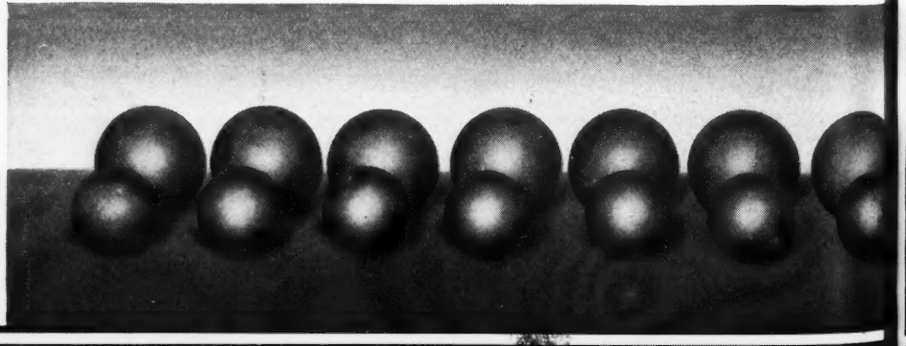
Send for this 96-page engineering data book No. 125.

LINK-BELT
Silverstreak
SILENT CHAIN DRIVES

Wear has little effect



New Balls –
Worn Balls –
(Still Spherical)



THE BABCOCK &

on Capacity or Fineness

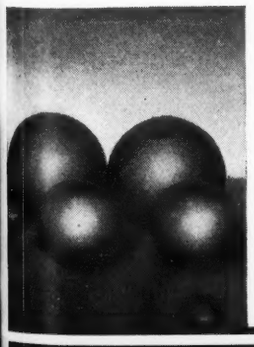
with the B & W PULVERIZER

Ball-Bearing Principle

Actual operating experience with almost 200 B&W Pulverizers direct firing boilers over periods of from one to eight years shows conclusively that they maintain capacity within close limits and fineness of output throughout the long life of the grinding elements. The balls remain spherical as they wear—they do not need re-surfacing.

The result is little outage for repairs, low average carbon loss due to drop in fineness, and low maintenance costs.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK, N. Y.



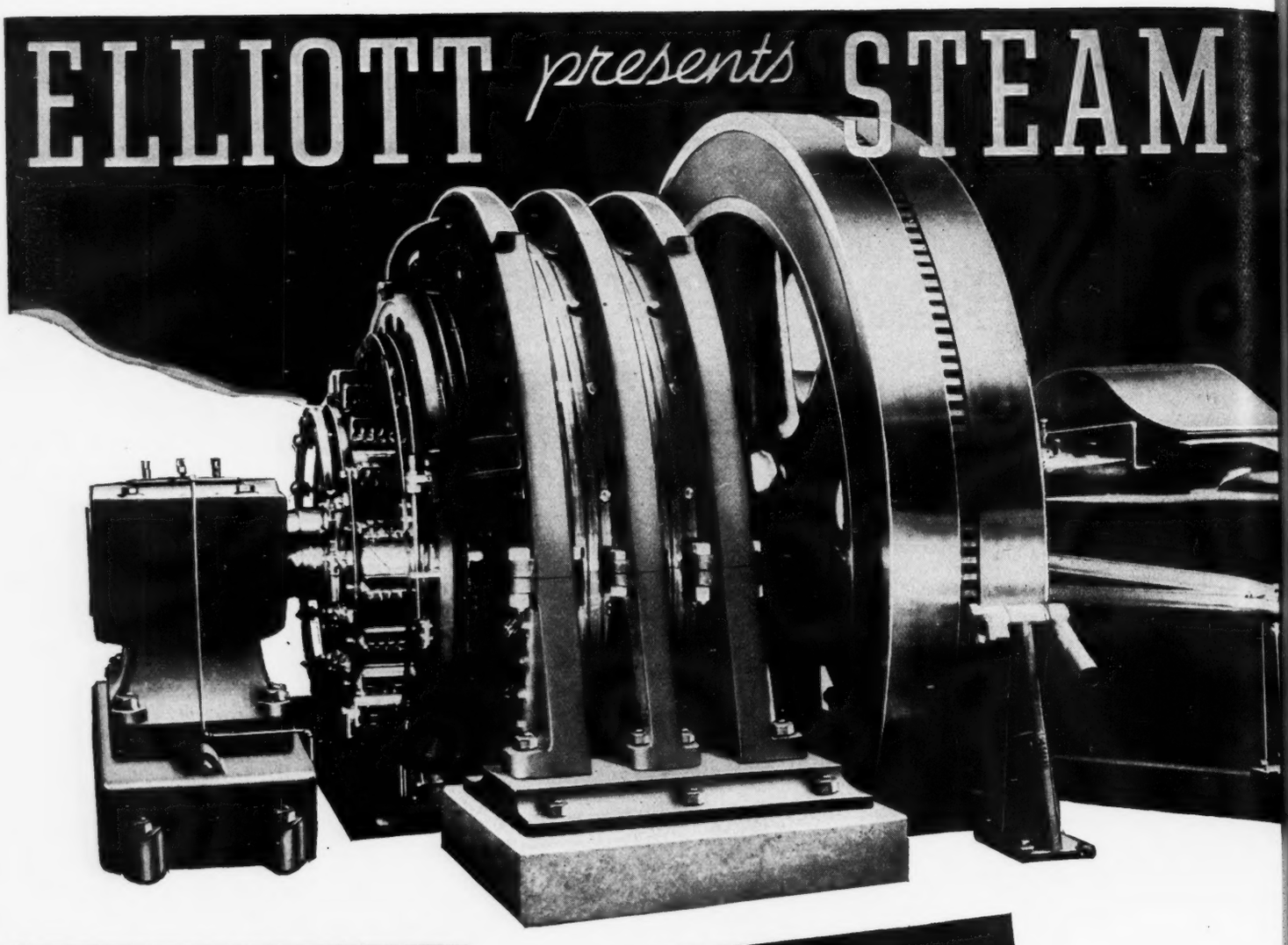
G 118-T

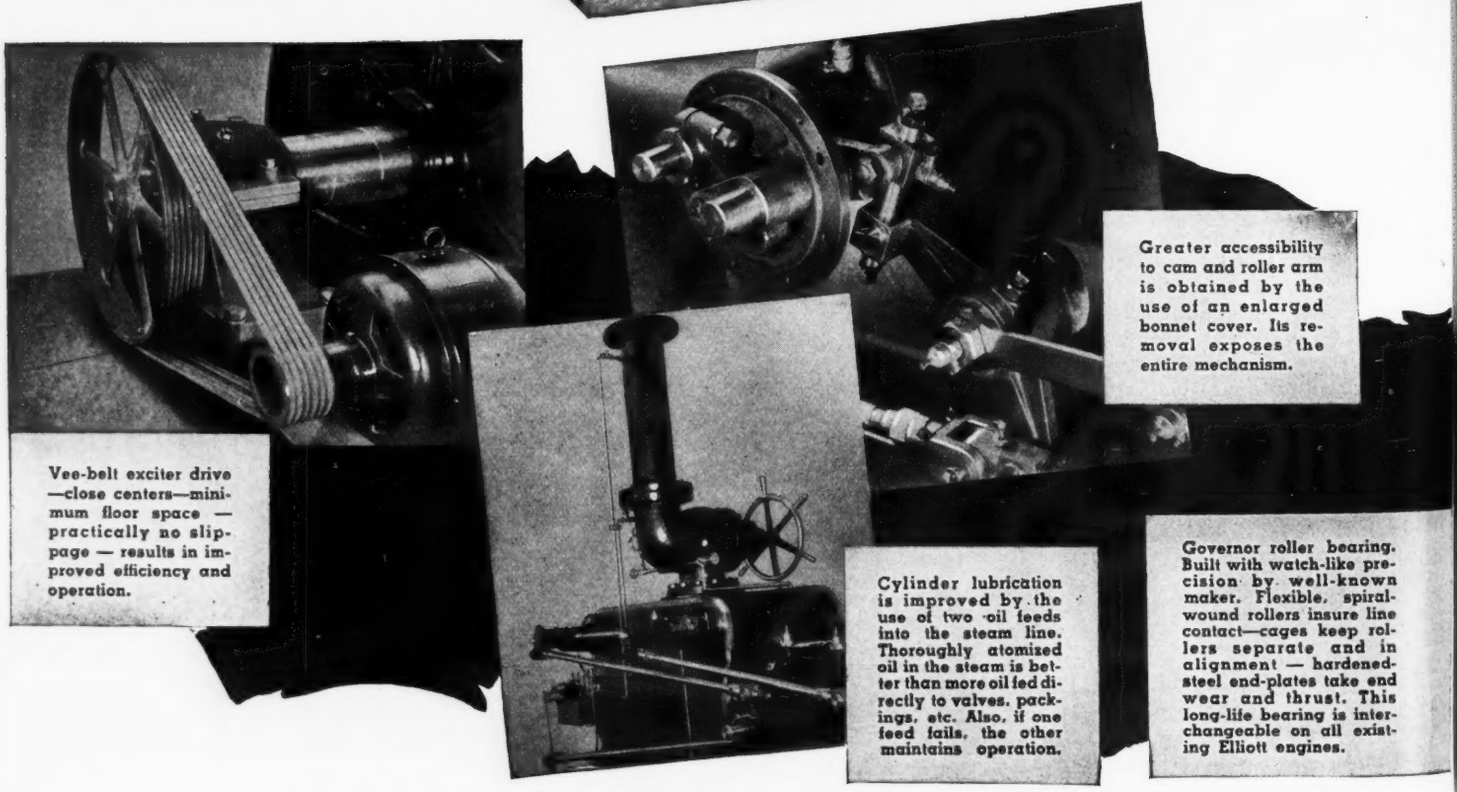
G-118 T

Bulletin G-19 contains further information on these features of the B&W Pulverizer . . . sent on request.

WILCOX COMPANY

ELLIOTT *presents* STEAM





Vee-belt exciter drive —close centers—minimum floor space — practically no slippage — results in improved efficiency and operation.

Greater accessibility to cam and roller arm is obtained by the use of an enlarged bonnet cover. Its removal exposes the entire mechanism.

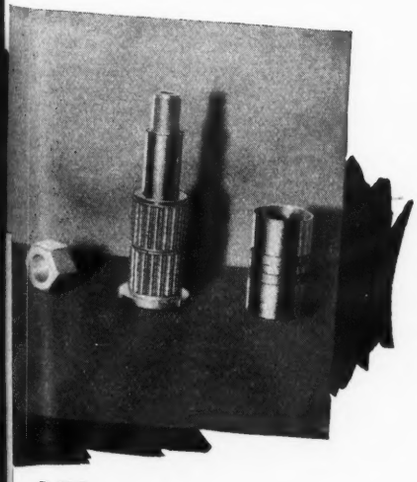
Cylinder lubrication is improved by the use of two oil feeds into the steam line. Thoroughly atomized oil in the steam is better than more oil fed directly to valves, packings, etc. Also, if one feed fails, the other maintains operation.

Governor roller bearing. Built with watch-like precision by well-known maker. Flexible, spiral-wound rollers insure line contact—cages keep rollers separate and in alignment — hardened-steel end-plates take end wear and thrust. This long-life bearing is interchangeable on all existing Elliott engines.

ELLIOTT COMPANY · · · STEAM ENGINE DEPARTMENT—

ENGINES *for* 1938

...and they're better than ever!



B-316

By continual study and development, it is always possible to make a good thing better. That's how Elliott engineers build smoother operation and more efficient performance into steam engines for 1938. A few of the many recent refinements are shown here.

Elliott engine-generators are unique in that they are built as complete units by a single manufacturer – the product of close co-operation between Elliott electrical and mechanical engineers.

Elliott engines are built for all sorts of drives and in four types – single-valve and four-valve counterflow; poppet-valve and Corliss-valve unaflow. Elliott engineers will help you select the unit which best suits your requirements.

We have bulletins telling what 48 years of engine building have done for the STEAM ENGINE of 1938.

RIDGWAY, PA., DISTRICT OFFICES IN PRINCIPAL CITIES

INDUSTRIAL POWER PLANTS OVER 200 LB.

UNITS SINCE JAN. 1, 1936

POWER
Section Two
Sections
September, 1937. Volume 81, Number 10
Publication Office, Albany, N. Y.
Editorial Office, New York, N. Y.

Name of Company and Location	Kind of Industry	Consulting Engineers
700 lb. per sq. in. and upwards		
Ford Motor Co., Dearborn, Mich.	Automobile	Ford Motor Co.
Firestone Tire & Rubber Co., Akron, O.	Rubber	Stone & Webster
Dow Chemical Co., Midland, Mich.	Chemical	C. W. E. Clarke, C. W. E. Clarke
Pittsburgh Plate Glass Co., Barberton, O.	Chemical	
Pittsburgh Plate Glass Co., Barberton, O.	Chemical	
Ford Motor Co., Windsor, Ont.	Automobile	
Weirton Steel Co., Weirton, W. Va.	Steel	
Eastman Kodak Co., Rochester, N. Y.	Photographic	
Industrial Rayon Corp., Painesville O.	Rayon	Gulf Oil Corp.
Gulf Oil Corp., Port Arthur, Tex.	Oil	Stone & Webster
Monsanto Chemical Co., Monsanto, Ill.	Chemical	Stone & Webster
Hammermill Paper Co., Erie, Pa.	Paper	
Hercules Powder Co., Wilmington, Del.	Chemical	Stone & Webster
General Foods Corp., Battle Creek, Mich.	Cereal	
500—699 lb. per sq. in.		
Humble Oil & Refining Co., Baytown, Tex.	Oil	G. Walmsley
Wheeling Steel Corp., Portsmouth, O.	Steel	C. W. E. Clarke
Johns Manville Co., Manville, N. J.	Insulation	Stone & Webster
Tennessee Eastman Corp., Kingsport, Tenn.	Chemical	
Chrysler Corp., Lodge Div., Detroit, Mich.	Automobile	Thos. E. Murray
Scott Paper Co., Chester, Pa.	Paper	Stone & Webster
Cleveland Worsted Mills Co., Cleveland, O.	Textile	
Port Huron Sulphite & Paper Co., Port Huron, Mich.	Paper	
Glen Alden Coal Co., Ashley, Pa.	Coal	
West Virginia Pulp & Paper Co., Luke, Md.	Paper	G. R. Wadleigh
West Virginia Pulp & Paper Co., Charleston, S. C.	Paper	G. R. Wadleigh
Carnegie-Illinois Steel Corp., Chicago, Ill.	Steel	Un. Eng. & Cons., Inc.
E. I. DuPont de Nemours Co., Buffalo, N. Y.	Chemical	
West Virginia Pulp & Paper Co., Williamsburg, Pa.	Paper	G. R. Wadleigh
Carnegie-Illinois Steel Corp., Youngstown, O.	Steel	
Ohio Boxboard Co., Rittman, O.	Paper	H. M. Wilson Co.
400—499 lb. per sq. in.		
Hersney Chocolate Co., Hershey, Pa.	Chocolate	
Jones & Laughlin Steel Co., Pittsburgh, Pa.	Steel	
McWilliams Dredging Co., Cnicago, Ill.	Sugar	E. L. Dennis
Godchaux Sugars Inc., Reserve, La.	Oil	Wood & Kirkpatrick
MacAndrews & Forbes Co., Camden, N. J.	Textile	J. A. Stevens, Inc.
Shell Petroleum Corp., Houston, Tex.	Dye	J. G. Berger
Sanford Mills, Inc., Sanford, Me.		
Hellwig Silk Dyeing Co., Philadelphia, Pa.	Leather	B. J. Di Santo
J. K. Mosser Leather Co., Williamsport, Pa.	Metal	H. H. Fales
American Smelting & Ref. Co., Perth Amboy, N. J.	Automobile	S. B. Roberts
Buick Motor Co., Flint, Mich.	Paper	
Byron Weston Co., Dalton, Mass.	Textile	
Celanese Corp. of America, Cumberland, Md.	Steel	
Carnegie-Illinois Steel Co., Chicago, Ill.	Chemical	F. L. Smith
E. I. DuPont de Nemours & Co., Belle, W. Va.	Chemical	
E. I. DuPont de Nemours & Co., Ampthill, Va.	Paper Board	
New Haven Pulp & Board Co., New Haven, Conn.	Dye	
Lanett Bleachery & Dye Wks., Lanette, Ala.	Chemical	Jenks & Ballou
Niagara Alkali Co., Niagara Falls, N. Y.	Glass	Stone & Webster
Libbey-Owens Ford Glass Co., Rossford, O.	Oil	
Pan American Refining Corp., Texas City, Tex.	Cellophane	
Sylvania Industrial Corp., Fredericksburg, Va.	Paper	G. F. Hardy
Union Bag & Paper Co, Savannah, Ga.		
Union Bag & Paper Co., Savannah, Ga.	Paper	G. F. Hardy
Union Bag & Paper Co., Savannah, Ga.	Paper	G. F. Hardy
Union Bag & Paper Co., Savannah, Ga.	Paper	G. F. Hardy
Wilshire Oil Co., Santa Fe Springs, Cal.	Oil	R. M. Parsons Co.
Pioneer Flintkote Co., Vernon, Cal.		
National Cash Register Co., Dayton, O.	Business Mach.	K. A. Lefren
Inland Paper Board Co., Versailles, Conn.	Paper	
Magnolia Petroleum Co., Beaumont, Tex.	Oil	
Morris Paper Mills, Morris, Ill.	Paper	
Staley Mfg. Co., Decatur, Ill.		J. E. Sirrine & Co.
Chesapeake Camp Corp., Franklin, Va.	Paper	
Diamond Braiding Mills, Inc., Chicago Hts., Ill.	Textile & Wire	
Canadian Kodak Co., Ltd., Toronto, Ontario	Photographic	
John Morrell & Co., Ottumwa, Ia.	Packer	Arthur Nelson
Owens Illinois Glass Co., Newark, O.	Glass	

86% OF THESE PLANTS *are equipped* WITH DIAMOND SOOT BLOWERS

Name of Company and Location	Kind of Industry	Consulting Engineers	New, Addition or Replacement	First Operation
Colgate Palm Olive Peet Co., Jersey City, N. J.	Soap	G. A. Anbro	Add	193
Rath Packing Co., Waterloo, Ia.	Packing		Add	193
Granite City Steel Co., Granite City, Ill.	Steel		Add	
Timken Roller Bearing Co., Columbus, O.	Bearings	H. A. Kuljian Co.	New	19
Viscose Co., Marcus Hook, Pa.	Rayon		Add	
E. I. DuPont de Nemours & Co., Richmond, Va.	Floor Covering		New	
Congoleum Nairn, Inc., Marcus Hook, Pa.			Add	
F. & M. Schaefer Brewing Co., Brooklyn, N. Y.			New	
E. I. DuPont de Nemours & Co., Parlin, N. J.			Add	
Great Lakes Steel Corp., Ecorse, Mich.	Steel		Add	
Union Pacific Coal Co., Rock Springs, Wyo.	Coal			
U. S. Rubber Products Co., Detroit,	Rubber	esdick & Hilmer		
Socony Vacuum Oil Co., Paulsboro,				
Beckett Paper Co., Hamilton, O.	Textile	Mr. Legrand		
Spring Cotton Mills, Lancaster, S. C.	Copper			
Phelps Dodge Corp., Douglas, Ariz.	Beverage			
Adolph Coors Co., Golden, Col.				
Franklin Board & Paper Co., Franklin, O.				
Champion Paper & Fibre Co., Canton,				
Below 300 lb. per sq. in.				
International Paper Co., Hawesville, Ky.	Paper	J. E. Sirrine & Co.		
Standard Oil of Indiana, Whiting, Ind.	Oil			
R. J. Reynolds Tobacco Co., Winston-Salem, N. C.	Tobacco			
American Cyanamide & Chem. Co., Bridgeville, Pa.	Chemical			
American Enka Corp., Enka, N. C.	Rayon Yarn			
Spreckel's Sugar Co., Woodland, Cal.	Sugar	A. M. Kinney, Inc.		
Hartford City Paper Co., Hartford City, Ind.	Paper	A. M. Kinney, Inc.		
Dresden Paper Co., Dresden, O.	Paper	W. G. Jonson		
Wolf River Paper & Fiber Co., Shawano, Wis.	Soap, etc.	A. M. Kinney, Inc.		
Andrew Jergens Co., Cincinnati, O.	Containers			
American Can Co., Marwood, Ill.	Baby Food	A. M. Ormond		
Mead Johnson & Co., Evansville, Ind.	Sugar			
Savannah Sugar Ref. Co., Port Wentworth, Ga.				
Wilson & Co., Albert Lee, Minn.	Meat	C. T. Main Co.		
Tubize Chatillon Corp., Rome, Ga.	Rayon	H. B. Wilson		
Simplex Wire & Cable Co., Cambridge, Mass.	Ins. Wire	Mr. Merkle		
Guide Lamp Co., Anderson, Ind.	Lamp	Loeb & Snaw		
Southern Extract Co., Knoxville, Tenn.	Extracts	H. P. Angerm		
Bemis Bros. Bag Co., Peoria, Ill.	Paper Bags	C. W. E. Cla		
Ebensburg Coal Co., Colver, Pa.	Coal			
General Aniline Co., Rensselaer, N. Y.	Dye			
United Refining Co., Warren, Pa.	Oil			
Collins & Aikman Co., Philadelphia, Pa.	Electric	H. A. Kul		
Stewart Warner Corp., Chicago, Ill.	Rayon			
Viscose Co., Roanoke, Va.	Paper Board			
Whippany Paper Bd. Co., Whippany, N. J.	Molasses			
American Molasses Co., Brooklyn, N. Y.	Molasses			
American Molasses Co., Brooklyn, N. Y.	Aluminum			
Aluminum Co. of America, Pittsburgh, Pa.				
Gonic Mfg. Co., Gonic, N. H.	Paper	Mr. Fe		
St. Regis Kraft Co., Tacoma, Wash.	Refrigerators	Deere		
Servel Inc., Evansville, Ind.	Tractor			
John Deere Tractor Co., Waterloo, Ia.		Deere		
Van Brunt Mfg. Co., Horicon, Wis.				
Dain Mfg. Co., Ottumwa, Ia.	Agr. Mach.			
Kentucky Gas Transmission Corp., Boldman, Ky.	Nat. Gas Trans			
Diamond Match Co., Oswego, N. Y.	Match			
Clearfield Bit. Coal Co., Indiana, Pa.	Coal			
Crowell Publishing Co., Springfield, O.	Publishing			
Firestone Tire & Rubber Co., Akron, O.	Rubber			
Agar Mfg. Co., Cnicago, Ill.	Containers			
Heekin Can Co., Norwood, O.	Oil			
Shell Oil Co., San Francisco, Cal.	Oil			
Shell Oil Co., San Francisco, Cal.				

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CENTRAL STATIONS OVER 200 LB.

UNITS INSTALLED SINCE JAN. 1, 1936

POWER

In Two Sections — **Section Two**

Mid-September, 1937. Volume 81, Number 10

Publication Office, Albany, N. Y.
Editorial Office, New York, N. Y.

90% OF THESE PLANTS

are equipped WITH

DIAMOND SOOT BLOWERS

Name of Company and Location	Plant Name	Consulting
800–999 lb. per sq in.:		
Indiana & Michigan Elec. Co., Mishawaka, Ind.	Twin Branch	
Ohio Power Co., Windsor, W. Va.	Windsor	
Pub. Ser. Elec. & Gas Co., Newark, N. J.	Essex	
Columbus Ry. Pr. & Lt. Co., Groveport, O.	Walnut	
Cincinnati Gas & Elec. Co., Cincinnati, O.	West End	
West Penn Power Co., Springdale, Pa.	Springdale	
Appalachian Elec. Pr. Co., Logan, W. Va.	Logan	
Consolidated Edison Co., New York, N. Y.	Waterside	
Boston Edison Co., Boston, Mass.	L Street	
Kansas City Pr. & Lt. Co., Kansas City, Mo.	Northeast	
Metropolitan Edison Co., Reading, Pa.	West Reading	
Milwaukee Elec. Ry. & Lt. Co., Milwaukee, Wis.	Port Washington	
Philadelphia Elec. Co., Philadelphia, Pa.	Schuylkill	
Nebraska Power Co., Omaha, Neb.	Omaha	
Commonwealth Edison Co., Chicago, Ill.		
Dayton Pr. & Lt. Co., Dayton, O.	Fisk	
West Penn Power Co., Windsor, W. Va.	Millers Ford	
Monongahela W. Penn Pub. Ser. Co., Fairmont, W. Va.	Windsor	
Narragansett Elec. Co., Providence, R. I.	Rivesville	
800–999 lb. per sq in.:		
Madison Gas & El. Co., Madison, Wis.	Blount Street	
Detroit Edison Co., Detroit, Mich.	Delray	
Williamsburg Pr. Plant Corp., Brooklyn, N. Y.	Williamsburg	
Potomac Edison Co., Cumberland, Md.	River	
Toledo Edison Co., Toledo, Ohio.	Acme	
Consumers Power Co., Bay City, Mich.	John C. Weadock	
Tampa Elec. Co., Tampa, Fla.	W. Jackson Street	
New Orleans Public Service, Inc., New Orleans, La.	Market Street	
Gulf States Utilities Co., Beaumont, Tex.	Neches River	
Hartford Elec. Lt. & Pr. Co., Hartford, Conn.	So. Meadow	
Virginia Elec. & Pr. Co., Richmond, Va.	Twelfth Street	
United Power Mfg. Co., Davenport, Ia.	Riverside	
Tucson Gas Elec. Lt. & Pr. Co., Tucson, Ariz.	East Peoria	
Central Illinois Lt. Co., Peoria, Ill.	Atkinson	
Georgia Power Co., Atlanta, Ga.	Bryce E. Morrow	
Consumers Power Co., Comstock, Mich.		
Consumers Power Co., Battle Creek, Mich.	Elm Street	
Ohio Edison Co., Springfield, O.	Mad River	
Southern Ind. Gas & Electric Co., Evansville, Ind.	Ohio River	
Penn Power Co., New Castle, Pa.	New Castle	
500–799 lb. per sq. in.:		
Cincinnati Gas & Elec. Co., Cincinnati, O.	Columbia	
Kansas Gas & Elec. Co., Wichita, Kan.	E. Wells Street	
Milwaukee Electric Ry. & Lt. Co., Milwaukee, Wis.	Buzzard Point	
Potomac Elec. Pr. Co., Washington, D. C.		
Conn. Lt. & Pr. Co., Montville, Conn.	Alexandria	
Virginia Pub. Ser. Co., Alexandria, W. Va.	Dresden	
New York State Electric & Gas Corp., Dresden, N. Y.	West End	
Keystone Pub. Ser. Co., Oil City, Pa.	Seward	
Penn Electric Co., Seward, Pa.	Pearl Harbor	
Hawaiian Electric Co., Honolulu, T. H.		
Indianapolis Power & Light Co., Indianapolis, Ind.		

Name of Company and Location	Plant Name	Consulting
Iowa Electric Light & Power Co., Cedar Rapids,		
Lyoke Power Co., Mountain Creek		
Rochester Gas & Electric Co., Rochester, N. Y.	Station No. 1	
Otter Tail Power Co., Fergus Falls, Minn.	Station No. 3	
Pacific Gas & Electric Co., Eureka, Cal.	Station No. 3	
	Wahpeton	
	Station B	
Manchester, N.		
	Steel Point	
	Conners Creek	
	Lafayette Street	
400 to 499 lb. per sq. in.:		
Central Ohio Power & Light Co., Findlay, Ohio		
	Woodcock	
	South Omaha	
	Station C	
	James H. Reed	
	Riverside	
Laclede Power & Light Co., St. Louis, Mo.		
Public Service Company of Indiana, Terre Haute, Ind.	Edwardsport	
Louisville Gas & Electric Co., Louisville, Ky.		
Fort Bend Utilities Co., Sugerland, Texas	Canal	
Lynn Gas & Elec. Co., Lynn, Mass.		
Long Island Lighting Co., Glenwood, L. I., N. Y.	Glenwood No. 2	
Philadelphia Electric Co., Philadelphia, Pa.	Richmond	
Public Service Co. of Colorado, Denver, Colo.	Valmont	
Upper Michigan Power & Light Co., Escanaba, Mich.	Groos	
Utah Power & Light Co., Salt Lake City, Utah.		
Central Maine Power Co., Bucksport, Me.	Provo	
Savannah Electric & Power Co., Savannah, Ga.	Riverside	
United Illuminating Co., New Haven, Conn.	English Street	
Public Service Co. of Indiana, Terre Haute, Ind.	Dresser	
Cleveland Electric Illuminating Co., Avon, Ohio.	Ashtabula	
Union Electric Light & Power Co., St. Louis, Mo.	Cahokia	
Municipal Plants:		
Board of Water & Electric Light Comm., Lansing, Mic.	Ottawa Street	
Municipal Electric & Water Dept., Winnetka, Ill.		
Dept. of Water, Light & Power, Kansas City, Kan.	Quindaro	
Rocky Mt. Public Utilities, Rocky Mt., N. C.	Lakeside	
City Water Lt. & Pr. Dept., Springfield, Ill.		
Municipal Electric Light Plant, Vineland, N. J.		
Regina Light & Power Dept., Saskatchewan, Can.		
Municipal Light & Power Plant, Ames, Ia.		
City of Ft. Collins, Fort Collins, Colo.		
Municipal Utilities, Marshall, Mo.		
Raton Public Service Co., Raton, N. M.		
Board of Water & Light Comm., Austin, Minn.		
Marshfield Water, El. Lt. & Pr. Co., Marshfield, Wis.		
Rock Rapids Municipal Power, Rock Rapids, Ia.		
Greenwood Light & Power Plant, Greenwood, Miss.		

	1937	1	B	60	250								
		1		50	236								
Add	1936	2	S	45	236								
Add	1936	1		21									
Add	1937	1		15	236	Sat.		5.0			0.66	4.5	
	1936	1	S		230	547		10.1				1.5	Dr
Add	1936				225-27	477		12.7	6.0			0.90	
												0.90	
												3.1	

ENGINEERING *that*

"BEST EVER"

Inspecting steam turbine bearings, running on Texaco Regal for years, the builder's representative pronounced them to be in the best condition of any he had ever seen.

17,520 HOURS

A company reports electric motors running 24 hours a day for two years . . . without servicing. Their anti-friction bearings are lubricated with Texaco Starfak.

TEXACO

SERVICE *gets results*

THE Texaco lubrication engineer gets results because he gets down into the work and assists in ways and means of working out economies.

And once he finds "trouble," he has the experience to know how to clear it up.

Every day, from every part of the United States, Texaco lubrication engineers report benefits to Texaco users. This service is real, practical, vital . . . and it's available *for you.*

These trained lubrication engineers are always ready for consultation on the selection and application of Texaco Industrial Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the United States. The Texas Company, 135 East 42nd Street, N. Y. C.

BIG CUT

A $4400 lubrication cost reduced to less than $3000 is the saving effected in a year by an eastern manufacturing plant, through the cooperation of a Texaco engineer cooperating with plant personnel.

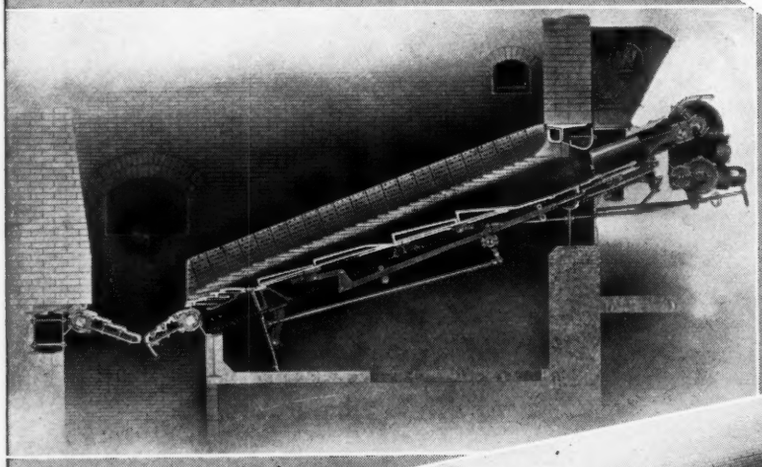
LONESOME PUMP-HOUSE

Operated by remote control, and practically never visited, an electrically-driven pump has been operating now for three years. Reason: the anti-friction bearings are lubricated with Texaco Starfak.

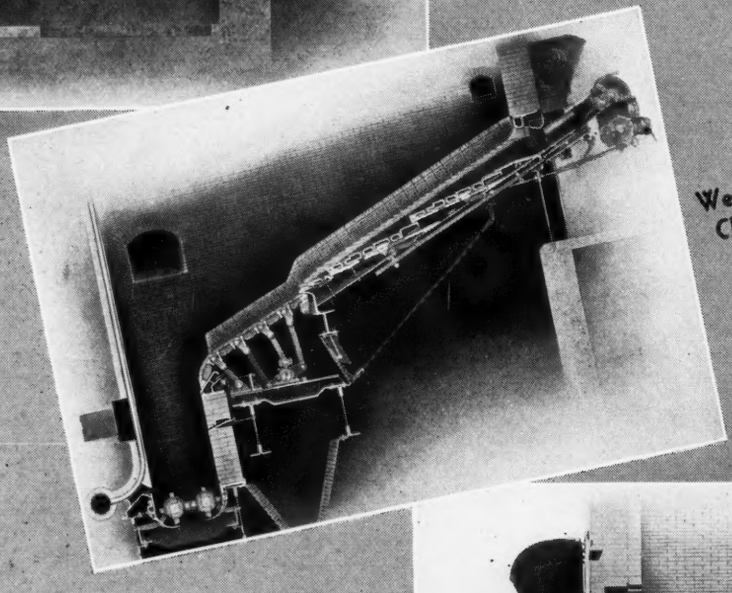
TEXACO REG. T. M.

INDUSTRIAL LUBRICANTS

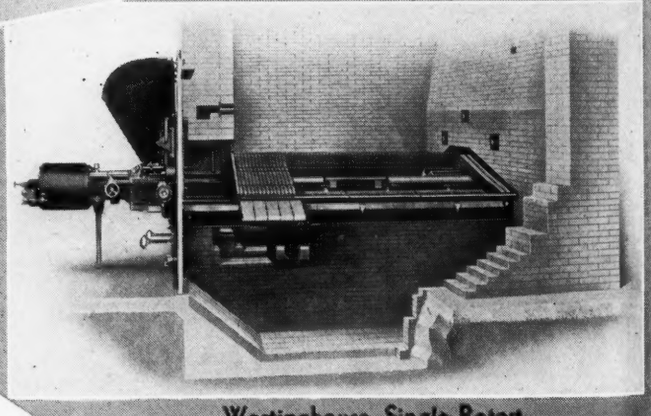
★STOKERS



Westinghouse Multiple-Retort Dump-Grate Stoker

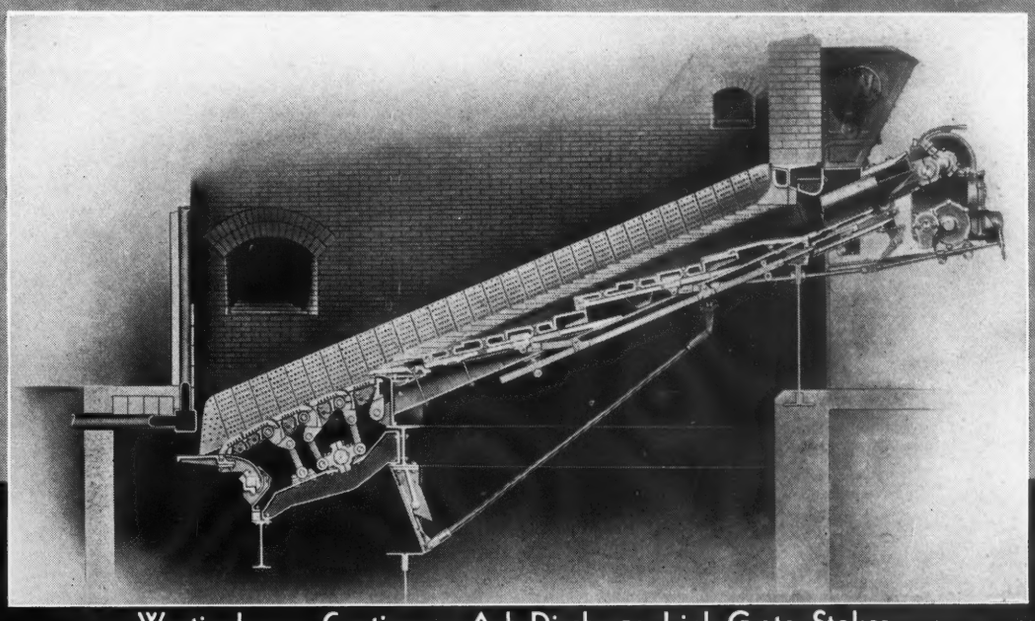


Westinghouse Link-Grate Clinker-Grinder Stoker



Westinghouse Single-Retort Stoker

OF ACHIEVEMENT



Westinghouse Continuous-Ash-Discharge Link-Grate Stoker

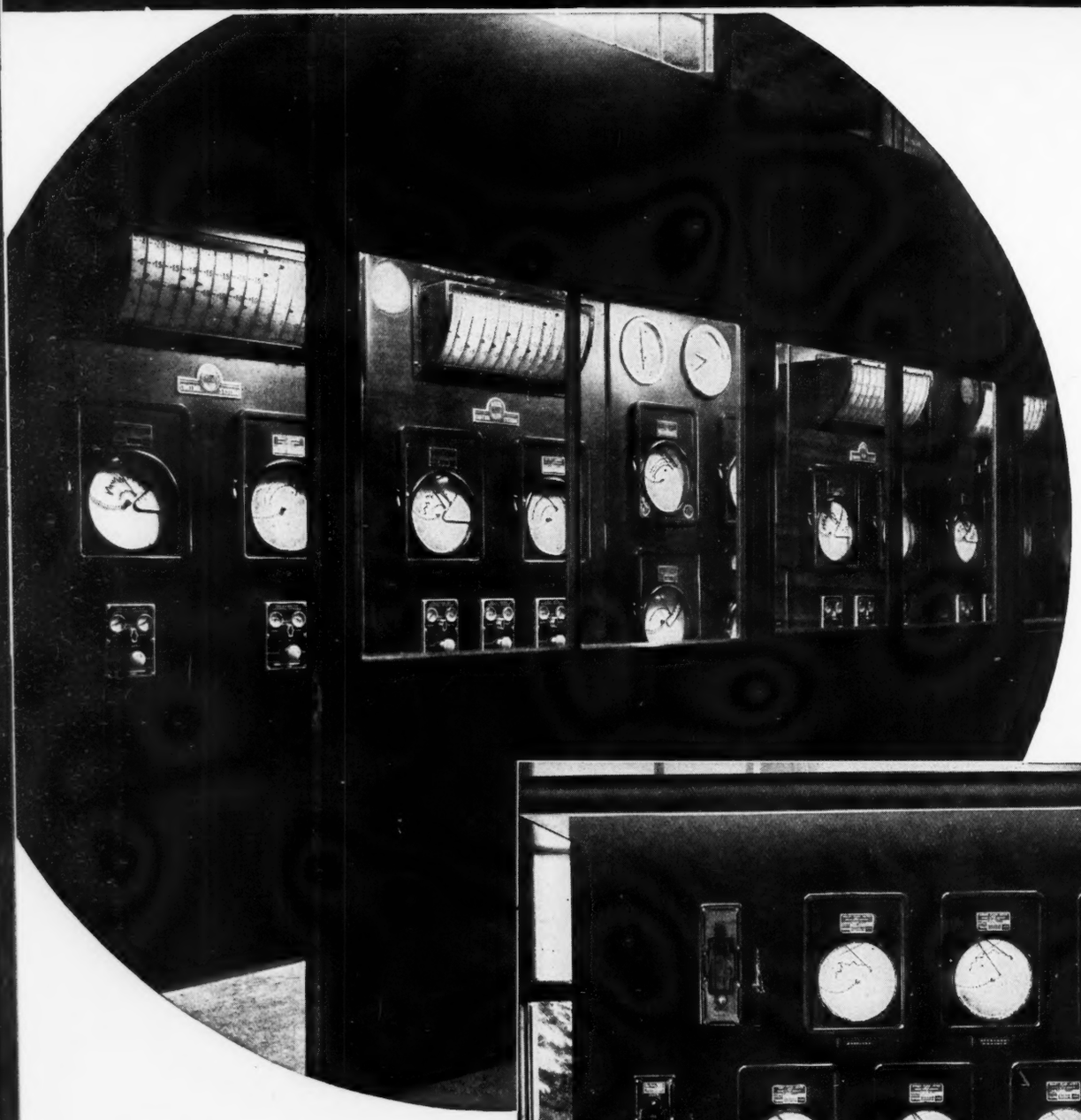
DEPENDABILITY
HIGH EFFICIENCY
LOW MAINTENANCE

Essential factors in low-cost steam generation

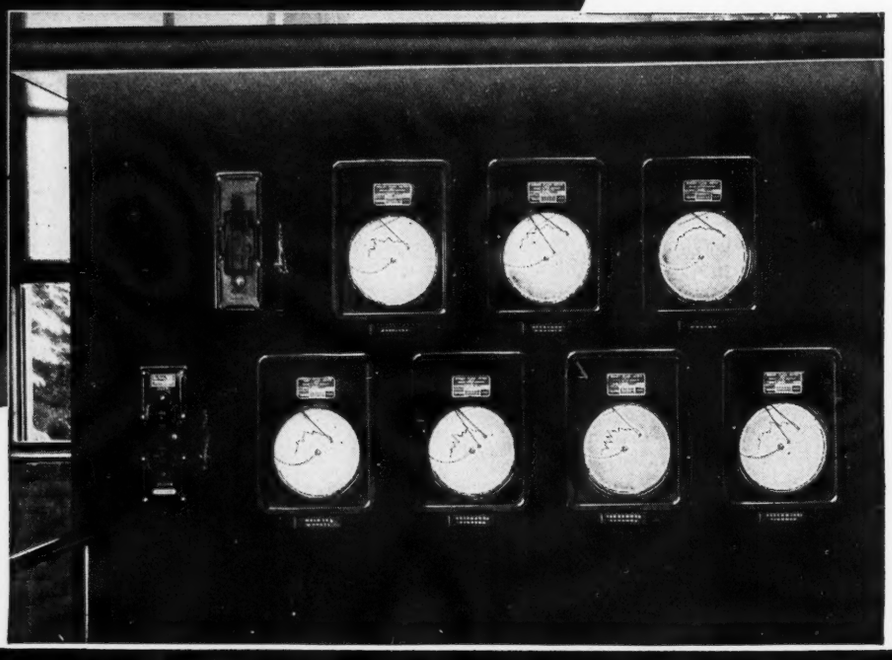
Westinghouse ***Stokers***

J 50041

A SERVICE FOR



Bailey Boiler Meters, Multi-Pointer Gages, Temperature Recorders and Air Operated Combustion Control installed on four 500 h. p. stoker-fired boilers in a steel mill power plant.



Bailey Fluid Meters measuring steam distribution and condensate return at a central heating plant.

BAILEY METERS

BOILER METERS

MULTI-POINTER GAGES

FLUID METERS

RECORDERS

BAILEY EQUIPMENT LINKS POWER PLANTS

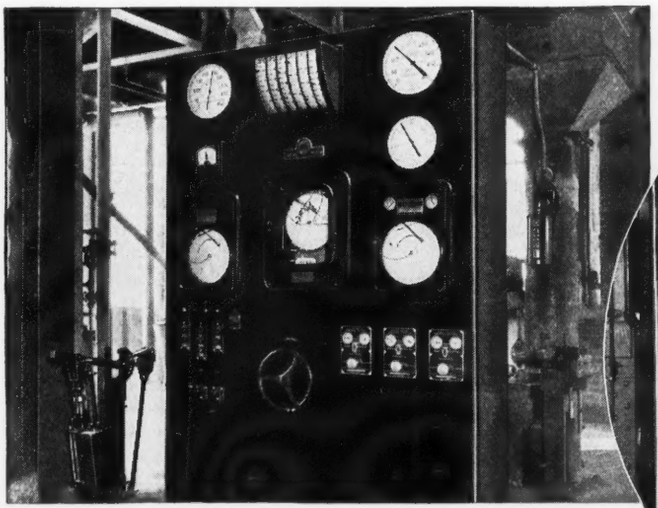
STEAM ECONOMY

Not Simply Meters and Control . . . But a Service Which Enables You to Secure Maximum Returns from Power and Process Equipment

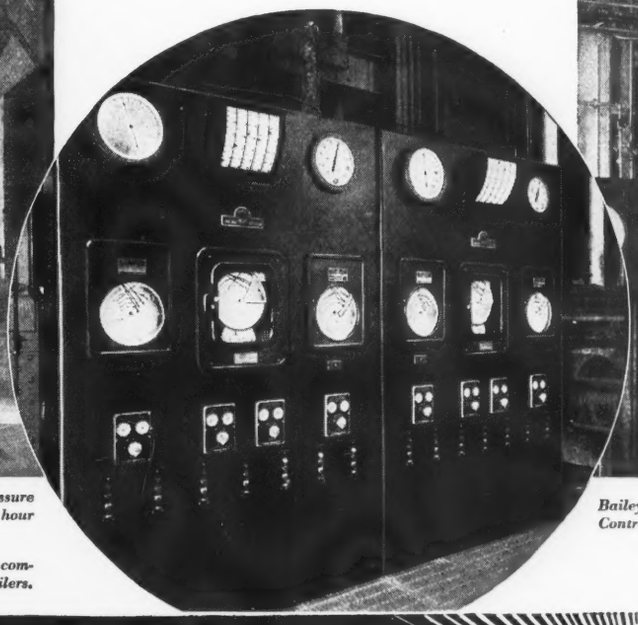
• Bailey Meter Engineering Service starts with a careful consideration of operating economies which may be obtained in the generation and utilization of steam and in the control of industrial processes. It continues with the application, design, construction, calibration, installation and adjustment of equipment necessary to effect the desired economies.

Through an experienced engineering organization, Bailey Meter Company offers you not simply meters and controllers but rather a service which makes it possible for you to secure the maximum returns from power and process equipment. G-4

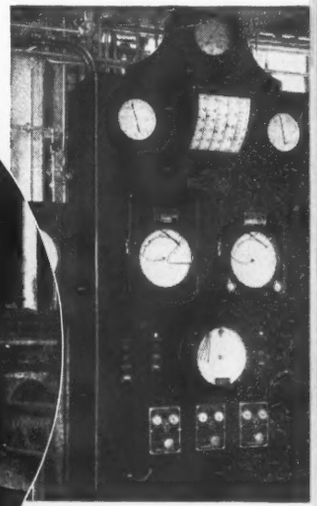
BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada



ABOVE — *Bailey Boiler Meter, Multi-Pointer Gage, Boiler Water Level Recorder, Pressure Recorder and Air Operated Combustion Control System installed on a 60,000 lb. per hour capacity pulverized coal-fired boiler.*



CIRCLE—*At the world's largest distillery, this Bailey Meter Control Panel furnishes complete records of boiler performance and automatically operates two 1380 h. p. Boilers.*



Bailey Meters and Combustion Control installed on a 1328 h. p. oil-fired boiler.

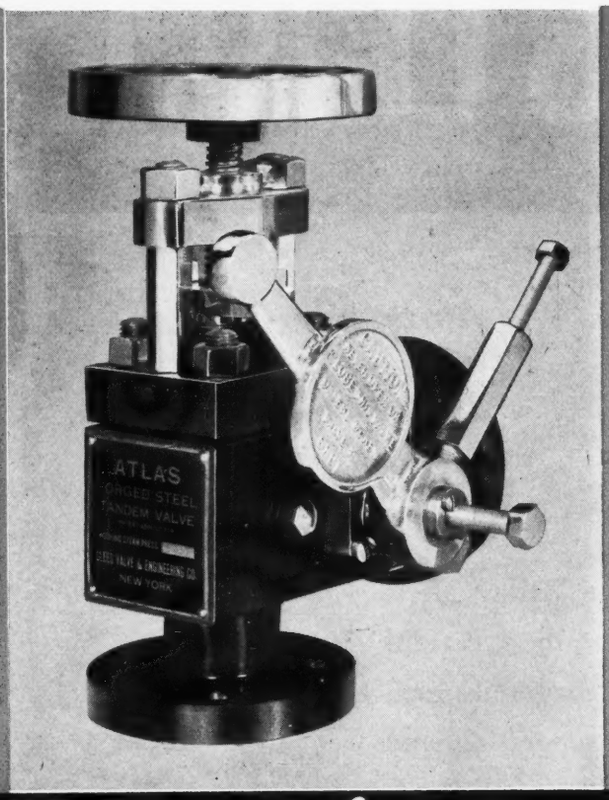
& CONTROL

TO ECONOMY, SAFETY AND RELIABILITY

ATLAS

Forged Steel

BLOW-OFF VALVES

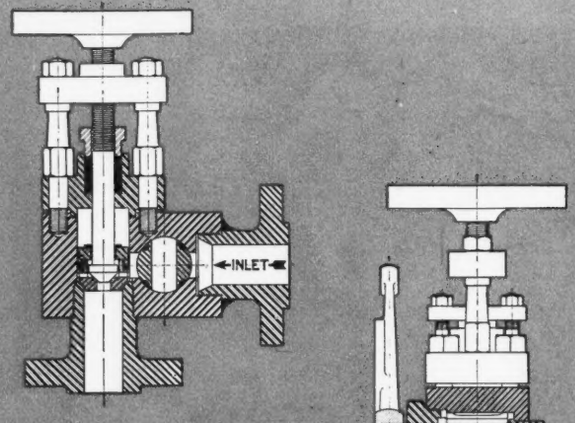


You asked for them . . .

• All requirements for your ideal in a blow-off valve are offered in the ATLAS and all are in actual operating service. We'll gladly name the plants.

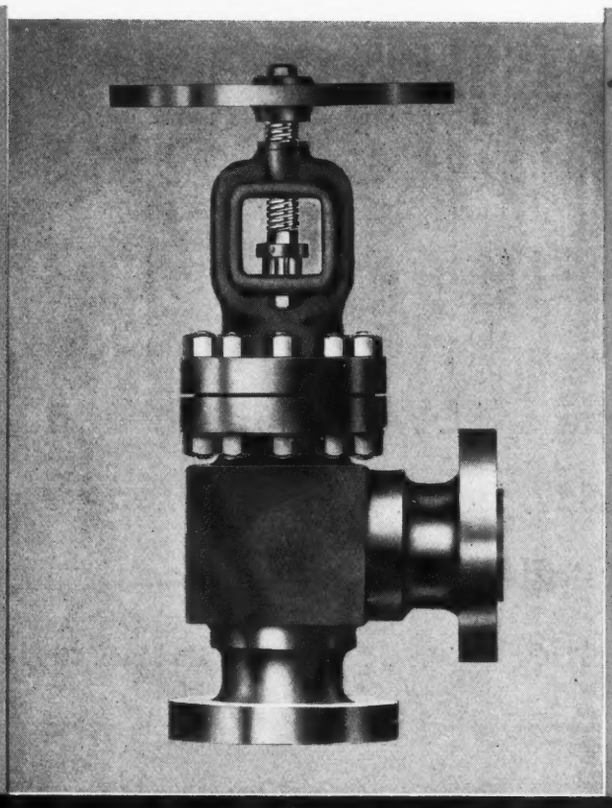
Here is a blow-off valve designed particularly for modern high pressure service, operated as easily at 1800 lbs. pressure as 250 lbs. and drop-tight at all pressures—a valve which can be repacked completely, safely and easily under pressure—a strong, compact, lightweight valve which cannot throttle its life away—a valve for continuous service and with greatly increased life.

These and other equally important long sought features are fully described in Bulletin No. 11. Send for a copy and see how ATLAS achieves them.



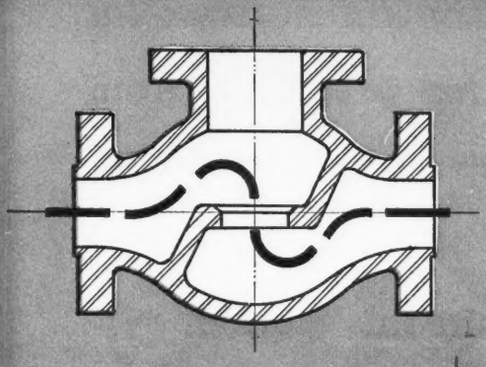
Illustrations show the 1¼" Valve. Larger sizes have solid head and flange at back of plug

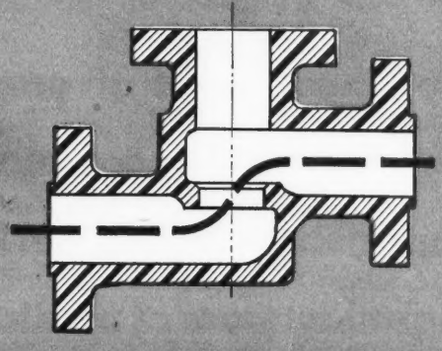
CLEES VALVE &
90 WEST STREET



New ATLAS Forged Steel HIGH PRESSURE TEMPERATURE VALVES

. . . . Here they are!





Compare the flow through a conventional globe valve shown above with that in the NEW ATLAS OFFSET VALVE below. The advantages offered by ATLAS design need no explanation.

• Here's another exclusive ATLAS achievement —a Forged Steel stop valve for highest pressures and temperatures — immediately available in standard sizes for pressures up to 1500 lbs. and temperatures to 850° F.—especially designed for pressures up to 2500 lb. W.S.P.

These new valves feature bodies, flanges and bonnets forged from the highest grade chrome Molybdenum Steel with trim of stainless steel and seats trimmed with Stellite. They are available with ends, either flanged or prepared for welding; they can be furnished with or without internal by-pass, with gasketted bonnet flange or bonnets seal-welded to body flange and without the use of gaskets.

Standard sizes from 2½ to 8" in both angle and offset types. The entire line is now available for reasonable delivery. Write for complete details.

ENGINEERING CO.

. . . . NEW YORK

Combustion Engineering's

in the steam generating field as

In the special issue of POWER, published in Mid-September, 1937, there was included as a supplement a detailed tabulation of central station and industrial power plant installations made since January 1, 1936. This tabulation, including contracts received up to about July 1, 1937, is reproduced in part as the background of these pages. The data given for steam generating units for pressures from 500 lb per sq in. and up appear to cover better than 95 per cent of all installations completed or begun within this period.

The summaries of these data given on the opposite page evidence the contemporary position of Combustion Engineering as designers and manufacturers of medium and high pressure steam generating units.

C·E

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Contemporary Position

revealed by POWER'S *statistics*

	Aggregate Capacity lb of steam per hr	Per Cent total capacity
Central Station Units for Pressures from 500 lb up		
Combustion Engineering	13,567,000	42
Other Manufacturers	18,485,000	58
Industrial Units for Pressures from 500 lb up		
Combustion Engineering	3,635,000	40
Other Manufacturers	5,374,000	60
Central Station and Industrial Units for Pressures from 500 lb up		
Combustion Engineering	17,202,000	41
Other Manufacturers	23,859,000	59
Central Station and Industrial Units for Pressures from 1000 lb up		
Combustion Engineering	9,145,000	54
Other Manufacturers	7,659,000	46

Central Station and Industrial Units having capacities from 500,000 lb up

The total of central station and industrial units having capacities from 500,000 lb per hr up is 19, of which 10 are C-E units.

NOTES: In all of the above classifications, except one, the figures for Combustion Engineering exceed those of any other of the seven manufacturers represented. If several C-E High Pressure Units, omitted from the POWER tabulation but installed or purchased between January 1, 1936 and July 1, 1937, were included in the above figures, Combustion Engineering would have a higher percentage of total capacity than any other manufacturer in all of the above classifications. C-E percentages would then be: Central Station Units—**45** per cent. Industrial Units—**46** per cent. Combined Central Station and Industrial Units—**45** per cent. Combined Central Station and Industrial Units from 1000 lb up—**60** per cent.

Several units listed in the POWER tabulation that include some C-E equipment are excluded from the above figures which are limited to those units in which boiler, furnace, firing and all or most of the related equipment were furnished by C-E.

A-381

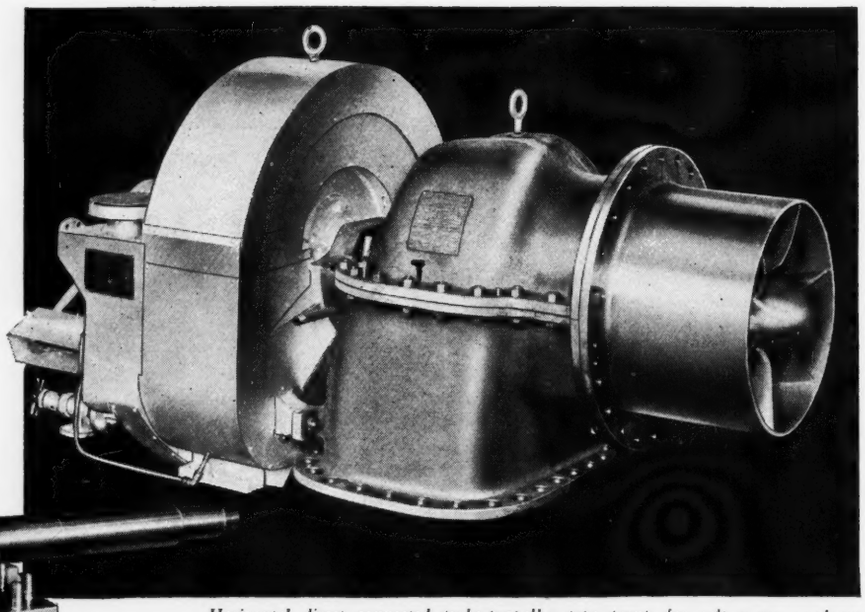
ENGINEERING

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

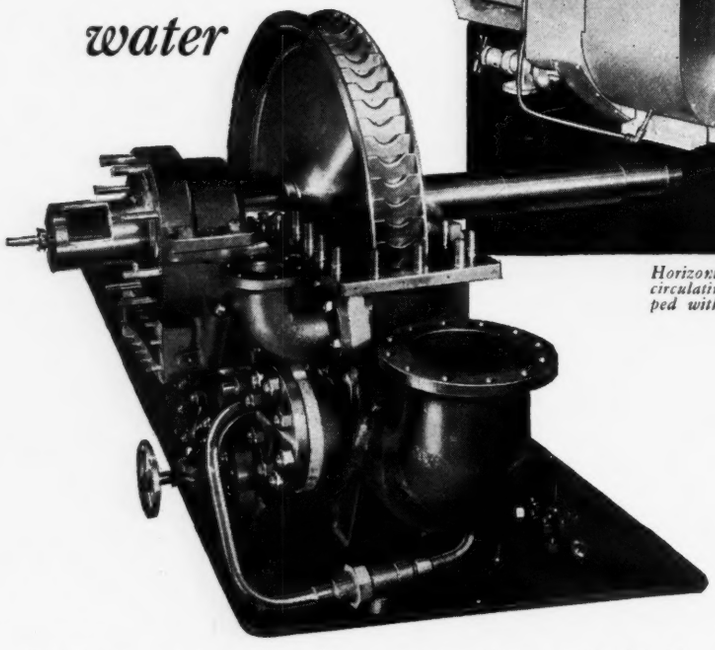
Circulates

MORE

water



Horizontal direct connected turbo-propeller type pump for salt water condenser circulating service as built by Worthington Pump & Machinery Corp., and equipped with single stage Sturtevant turbine.*



Both the pump impeller and the turbine rotor are mounted on a single shaft of heat-treated "K" Monel with integral wearing sleeves at four points where shaft passes through turbine bearings, steam glands, pump bearings and pump gland. Propeller type impeller is of cast "H" Monel.

with

LESS

space and weight

THE condenser circulating pump shown here has a capacity of 19,500 gallons a minute. And it does that job with the utmost in compactness: An overall length of 6 feet, 3 inches. Does it, too, with the utmost in sturdy long life.

The unique design of this pump, which mounts turbine rotor and pump impeller *on the same shaft,* makes possible the saving in space. And it takes the combination of "K" Monel's properties to make possible this design.

In the new heat-treatable "K" Monel, we offer you a metal which sacrifices none of Monel's resistance to corrosion . . . but by heat treating gains even greater strength, hardness and resistance to abrasion.

The higher physical properties now attained in "K" Monel are:

Tensile strength	**140,000 psi (minimum)**
Yield strength	**110,000 " "**
Elongation in 2"	**15% minimum**
Approx. hardness	**265-315 Brinell**

Consultation is invited on any of your problems where this rare combination of properties may cut *your* costs.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street • New York, N. Y.

Possible to mount both rotor and impeller on one shaft because of these *properties of "K" Monel:*

1. **High strength, stiffness and torsional properties for transmitting power without vibration.**
2. **Hardness to resist abrasion and scoring.**
3. **Resistance to corrosion and pitting in salt water.**
4. **Galvanic neutrality when coupled with bronze pump bodies and bearings and cast Monel impellers mounted on the shafts.**
5. **Low heat transfer between cooling water contacted at one end of the shaft and super-heated steam at the other.**
6. **Good bearing properties with babbitt metal in hot turbines.**
7. **Low coefficient of expansion for clearance in babbitt bearings when cold without danger of seizing at high operating heats.**

MONEL Ni Mo MONEL

* Monel is a registered trade-mark applied to an alloy containing approximately two-thirds Nickel and one-third copper. This alloy is mined, smelted, refined, rolled and marketed solely by International Nickel.

IT FLOATS THROUGH THE HOSE WITH THE GREATEST OF EASE

A typical example of Goodrich improvement in rubber

UNLOADING a car of cement or any such bulk material used to require an expensive gang of laborers, who had to sweat and strain with heavy bags which cost money to make and fill, and more money to handle. A machinery manufacturer, searching for a more efficient way, invented a machine to do the work.

Propelled, under its own power, into a car of bulk material (no expensive bags necessary) this hungry little machine picks up cement on a revolving disk, passes it through a "pusher" screw into the hose. The cement isn't *blown* through with strong air currents; just enough air is drawn in to cushion each cement particle and let it float or be pushed along like a liquid.

A large hose was needed, so light the machine could pull it around easily yet one that couldn't kink or flatten out at sharp corners. A new problem for Goodrich but solved in the same way, by the same technical men, who each year make improvements in water hose, air hose, fire hose, conveyor belts and hundreds of other industrial rubber products.

When you buy Goodrich rubber rolls, tank linings, belting, packing—you are buying products of this same Goodrich research which is constantly at work to develop new products for industry and make standard products better. No wonder Goodrich products keep your plant efficiency high, maintenance costs low. For greater value in the rubber products you buy, see your Goodrich distributor. Write us for his name if you don't know him. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

Another story of Goodrich development work appears on last page

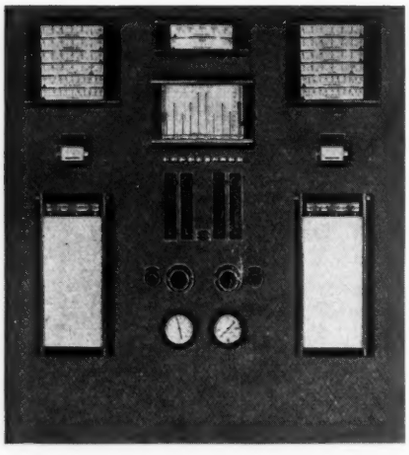
EQUIPMENT ★ ★ FACILITIES ★ ★ EXPERIENCE ★ ★ PERSONNEL

REPUBLIC INSTRUMENTS

SMOOT CONTROL

REPUBLIC • SMOOT

covering every aspect of **control** and **measurement** in the modern boiler room



Centralized Republic-Smoot master control and individual control panel for an entire central station boiler room. Instruments include Republic Multi-Point Indicators of flow, CO_2, stokers speed, drafts and pressures. Republic Strip-Chart Recorders provide records of all functions.

For many years it has been the business of the Republic Flow Meters Company to supply essential equipment for the functions of boiler room control. Today's problems and practices definitely require a much broader service . . . a service that embraces **all** phases of regulation and measurement as a part of **complete boiler room control.**

The Republic Flow Meters Company offers such a service for the first time, all or any part of which is available to power engineers and executives working toward a

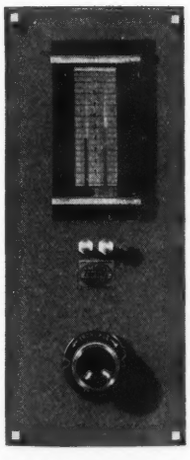
single well-defined objective—**economy.** In rounding out our facilities and products we have had in mind, what we believe to be a very important point: that boiler room control divides into two separate and distinct parts; . . . the mechanical control equipment necessary to operate boilers, stokers and auxiliaries efficiently, . . . and the instruments which witness and record the operation of both individual units and the plant as a whole.

It is on this basis that the Republic Flow Meters Company invites investigation and discussion of the following services and equipment.

Smoot Series "50" oil operated Regulator featuring sensitivity, power, speed and stability.

SMOOT CONTROLS: A full line of control equipment for the mechanical control of steam pressure, combustion, furnace pressure, excess pressure, load distribution, etc. Furnished for all sizes and types of boilers and fuel firing equipment.

SERVICE IS *Complete*



Smoot single unit Master Controller for the control of one boiler or a battery of boilers operated as a single unit.

REPUBLIC INSTRUMENTS: A complete line of power plant instruments including Flow Meters, CO_2 Meters, Draft Instruments, Thermometers, Level Gauges, etc. Master Panels are designed and built to meet special requirements and may include any combination of instruments desired.

More efficient and economical operation of present boiler room equipment, and a sound basis for recommendation of modernization or enlargement, are matters which vitally concern every power executive and consulting engineer. We place our newly expanded facilities and engineering staff freely at your service whether your problem involves a single instrument or modernized control of an entire power plant. This service is available through a nationwide organization of sales and service engineers. Your inquiries will imply no obligation.

★

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PARKWAY • CHICAGO • ILLINOIS

YOU PROFIT or WE PAY

In place of high-powered sales talk . . . in place of unproved superiority claims . . . *we* give you *guaranteed* increased production.

In your plant — on any belt drive where increased production can be measured — Research Leather Belting will increase average machine production 1 or 2% over ordinary belting . . . or you can have your money back!

Special Processes developed in our Home of Research gives Research Belting greater transmission capacity — greater resistance to stretch, greater coefficient of friction.

In plant after plant, mill after mill, Research Belting is helping to speed up production — and substantially reduce production cost.

Place an order today — with the nearest jobber or office listed in our insert in THOMAS' REGISTER. Put research on an important drive where increased production can be measured. Then add the production bonus to net profit.

Remember — *you* get the bonus, or *we* refund your money.

GUARANTEE

Research Leather Belting will increase average machine production at least 1 or 2% over ordinary belting or the full purchase price will be refunded in exchange for the belting.

Graton & Knight Company

1 OR 2% ANYWAY — PROBABLY MORE

Most of our customers' reports tell of bonuses greatly exceeding 2%. Such as —

Grinder: 8% more production an hour
Blower: Speed increased from 2700 to 2800 r.p.m.
Card: 4% more production
Compressor: So much more air from one, another could be shut down
Head rig: Research does twice as much work
Linter: Over 3 tons more per day
Spinning frames: 15 feet more yarn per hour
Drill: 25% saving in cost of operation
Vertical drive: 9% more r.p.m.
Compressor: 17 2/3 cents extra profit on each tank of chemical
Generator: 15% more power
Looms: $2.88 a year bonus per loom

Graton & Knight sales offices and distributors are located throughout the country to give 24 hour service or better to all points. The sales offices are indicated by stars. Dots show the distributors. Names and addresses are listed in the Graton & Knight insert in the Belting Section of the 1937 Thomas' Register.

MODERN PTC GROUP-DRIVE

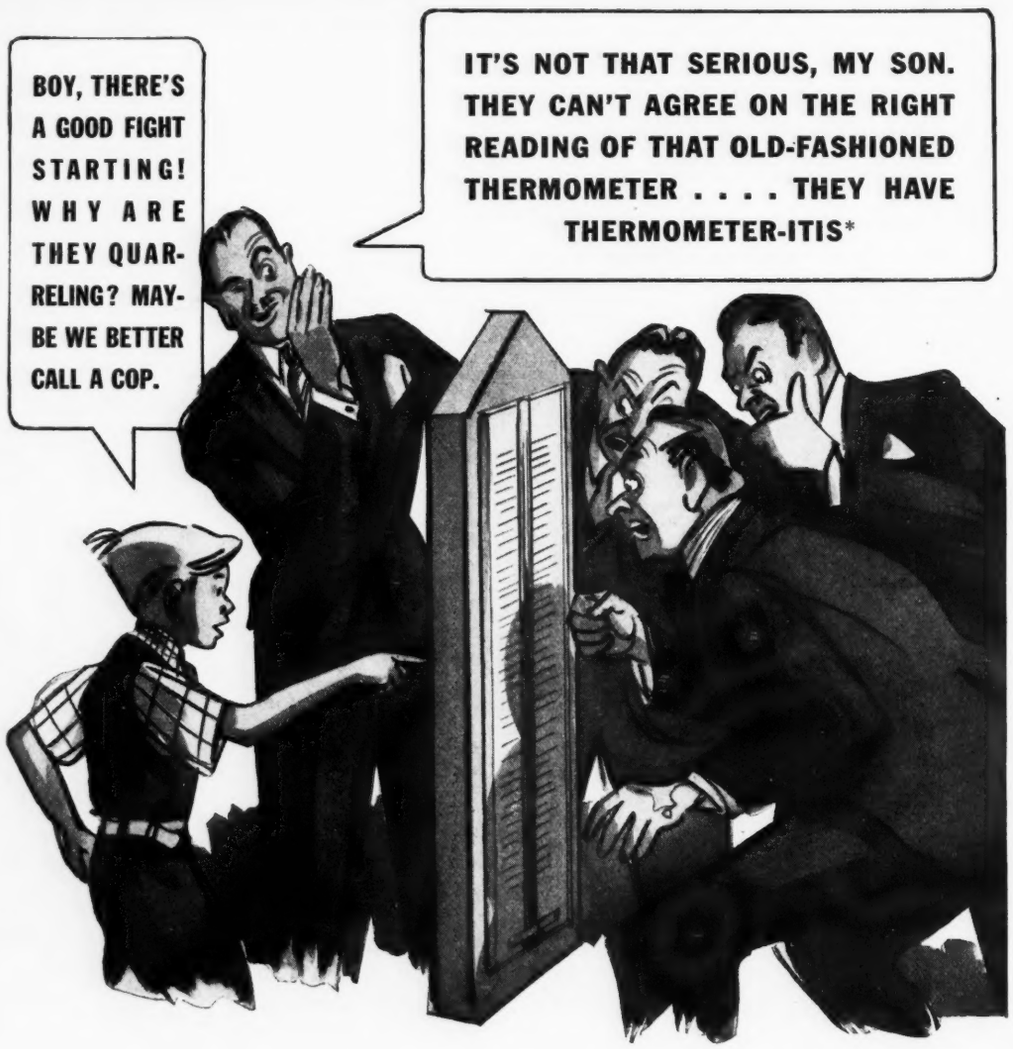
Graton and Knight

RESEARCH BELTING

from the Home of Research, Worcester, Mass.

Don't let your thermometers

Bore reflections in old-fashioned industrial ther- have tricked many an honest employee. Taylor Tubing eliminate such reflections . . . show the one


BOY, THERE'S A GOOD FIGHT STARTING! WHY ARE THEY QUARRELING? MAYBE WE BETTER CALL A COP.
IT'S NOT THAT SERIOUS, MY SON. THEY CAN'T AGREE ON THE RIGHT READING OF THAT OLD-FASHIONED THERMOMETER . . . . THEY HAVE THERMOMETER-ITIS*

***THERMOMETER-ITIS**—caused by trying to see temperatures on hard-to-read thermometers. Recognized by squinting . . . seeing temperatures that are not there . . . acting as if nearsighted . . . moving head and body from side to side when making a reading.

FOOL YOU

mometers with single-lens tubing

Thermometers with triple-lens BINOC

correct temperature at every reading

AS A MIRAGE has often tricked the senses of desert travelers, bore reflection in industrial thermometers of the past has deceived the the honest eyes of trained employees, and defeated quick, easy, accurate temperature readings. For in the attempt to make a reading from an improper angle, reflection in the empty bore above the mercury column has made the mercury appear higher than it actually was.

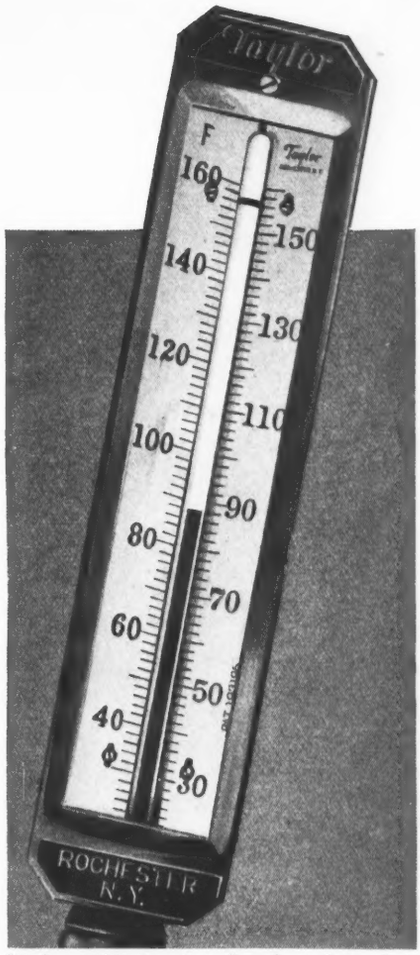
But now you can forget bore reflection ever existed. Taylor Engineers have killed it in their remarkable new development—BINOC Tubing. They evolved an optically correct glass tubing with a scientifically determined triple-lens front. The light which caused bore reflections is diverted or excluded.

Examine BINOC Tubing in a Taylor Thermometer. You will discover what many other plant executives have found—that the one quality industrial thermometers have always lacked before is now supplied by BINOC Tubing—EASY READING.

BINOC Tubing more than doubles the angle of vision within which you can see and read the mercury column. Its triple-lens construction concentrates more light, more intensely, on the column and makes it stand out in bold relief. BINOC Tubing makes Taylor Thermometers two to five times easier to read, yet it loses nothing in magnification.

BINOC Tubing gives Binocular Vision. It ends the need for close-range reading with one eye squinting. It assures accurate reading with great ease at longer distances—*with both eyes open.*

It will pay you to test Taylor Industrial Thermometers equipped with BINOC Tubing. See for yourself how this new development gives you quicker, more accurate readings, aids in eliminating costly mistakes, guards product uniformity and quality. For an immediate demonstration, ask a Taylor Representative or write direct to Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada.



No chance of inaccurate readings due to bore reflection with this bold, clearly defined mercury column. BINOC Tubing makes Taylor Thermometers as easy to read as a newspaper headline.

Taylor
INDUSTRIAL THERMOMETERS
with BINOC *tubing*

REG. U. S. PAT. OFF.

GET NEW FEVER THERMOMETER WITH BINOC TUBING

After the development of BINOC Tubing for Industrial Thermometers Taylor turned its attention to the use of this remarkable product in fever thermometers. Taylor BINOC Fever Thermometers are now being introduced through the drug stores of the country. They have the same triple-lens construction that assures greater visibility. *They have shown that they are three times easier to read than other high quality fever thermometers.* The flattened tubing makes them easier to handle and more convenient to use. These remarkable new thermometers are as great an aid in the home as BINOC Industrial Thermometers are in industry.

If you want one of the new BINOC Fever Thermometers, and your druggist cannot supply you, just fill out the coupon, giving name of your regular druggist, and mail it with check or money order.

TAYLOR INSTRUMENT COMPANIES
Dept. P-12-15, Rochester, N. Y.

I enclose { check / money order } for the BINOC Fever Thermometer (oral type, with case) checked here. My regular druggist is

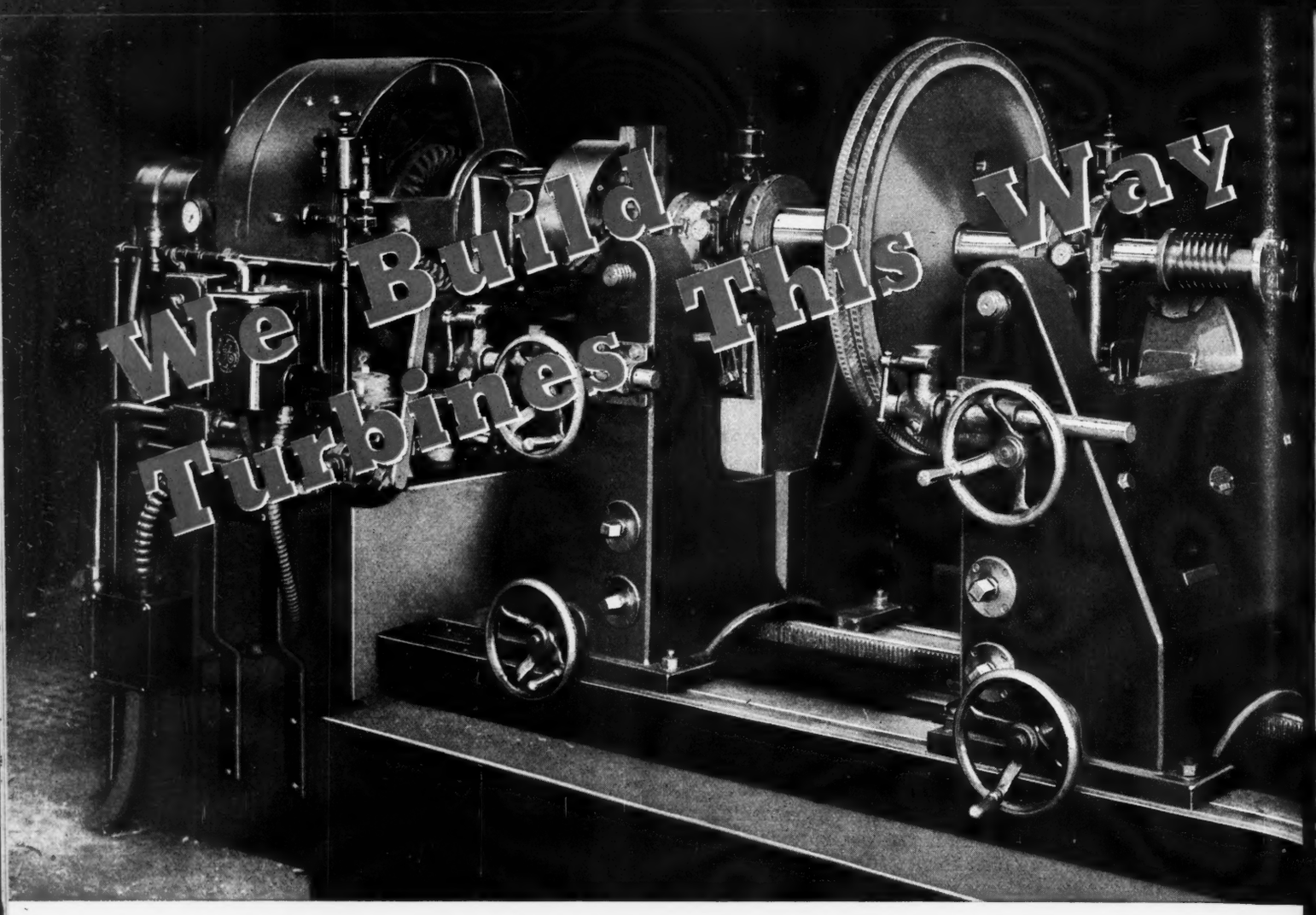
_____
(Name of retail store—and address)

_____ Taylor BINOC Fever Thermometer $1.50 each—
_____ Taylor-Tycos BINOC Fever Thermometer $2.00 each

Name _____

Address _____

City _____ State _____



A glimpse into the world's largest small-turbine workshop

DYNAMIC BALANCE

YOU are visiting the world's largest small-turbine workshop—the small-turbine engineering and manufacturing departments of the General Electric Company. In these shops are performed the tests and multiple checks that guarantee G-E quality. Here you see G-E performance in the making.

Many years ago General Electric turbine engineers pioneered in the study of turbine rotor vibration and its destructive effects. Today, as a result of that early work, this problem has been solved by improved rotor designs and by such tests as the one you see. This method, known as the Lawaczeck-Heyman system, makes it possible to measure and correct any tendency toward rotor vibration before the completed turbine is ever tested under steam.

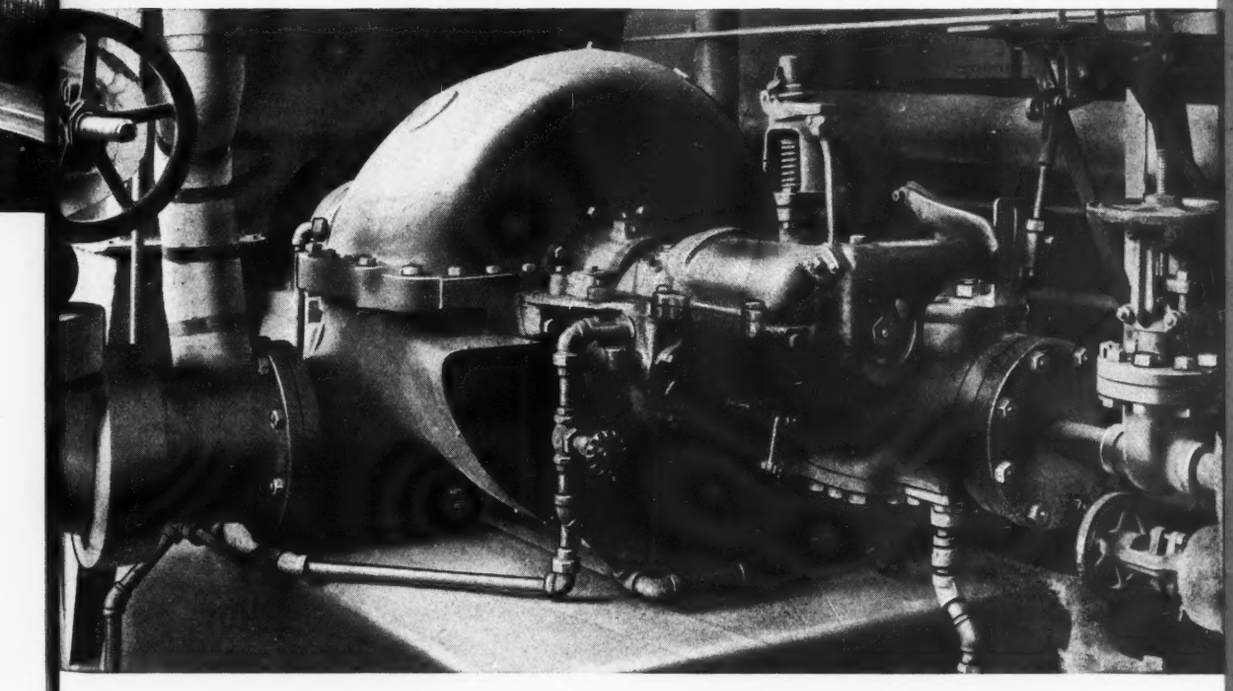
The rotor under test, at the right, is brought up to speed and allowed to rotate supported only by the flexible vertical springs under each bearing block. Sensitive micrometers tell the engineer of the slightest vibration. If vibration is present, the rotor is brought to rest and weight added, first at one end and then at the other, to correct for the slight unbalance. This process is repeated until the amplitude of vibration does not exceed 2/1000 inch! Only then is the rotor passed—*dynamically balanced.*

This is but one of the tests used in General Electric's small-turbine workshop. There are scores of others—each a part of that painstaking attention to detail and the never-ending search for improvement that have made General Electric apparatus unequaled in quality and unsurpassed in service.

G E N E R A L

For Service Like This!

Five Years of SERVICE
43,000 Operating Hours
Total Maintenance—$96.01
100 Per Cent Reliability



THIS 90-horsepower G-E turbine drives the boiler-draft fan in a large Eastern manufacturing plant. The unit has never been out of service during plant operation

More than five years ago this G-E turbine was selected as the most dependable and economical means of driving the boiler draft fan in a large Eastern manufacturing plant. Today, the record shows how completely that selection has been justified—five years of service, 43,000 hours in actual operation, with a maintenance cost of less than $20 a year.

We know that performance like this will interest you. A turbine specialist from your nearest G-E office can render valuable assistance in determining the needs of your plant. He can give you full details of G-E equipment and service. Or, write General Electric, Schenectady, N. Y.

ALSO IN THIS ISSUE

INSULATED CABLE

Now this new machine makes G-E varnished - cambric - insulated cable even more uniform. Other pictorial highlights of an interesting story of manufacturing control. See page 135.

PROTECTION OF ROTATING EQUIPMENT

G-E protective capacitors and lightning arresters provide a three-way protection for rotating machines against lightning. They are low in cost and easy to install. See page 162.

720-258

E L E C T R I C

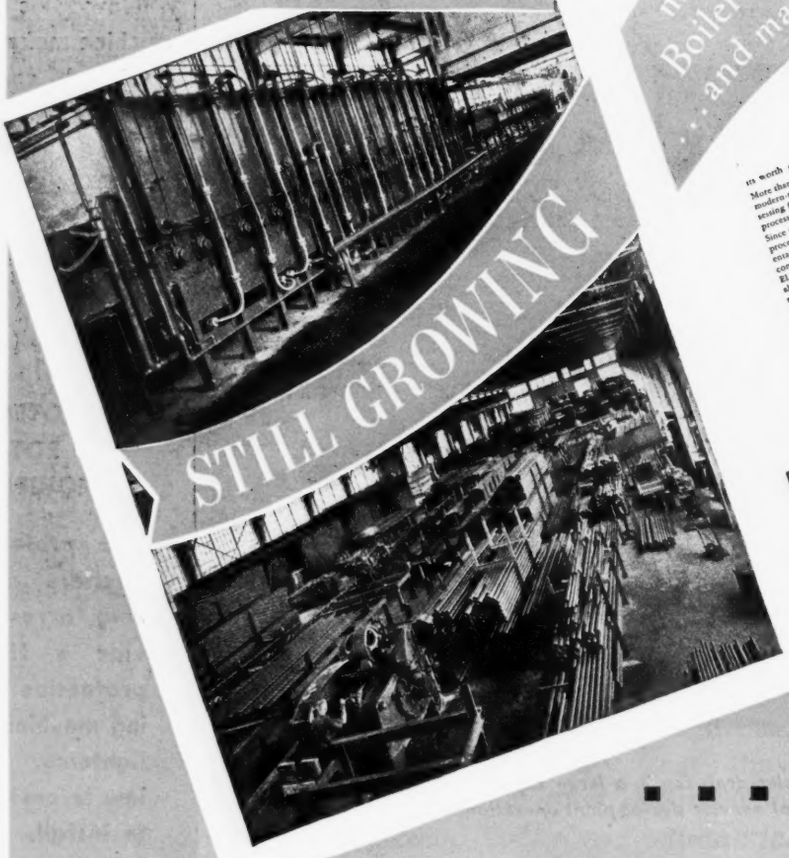
ELECTRUNITE

REG. U.S. PAT. OFF.

STEEL & TUBES ELECTRIC WELD

BOILER TUBES

IN 1936



making more Electrunite Boiler Tubes than ever before ... and making them better

its worth can be measured before long by the demand for it.

More than four years ago, Steel and Tubes, Inc., introduced a new, modern-type boiler tube, electrically resistance welded and possessing features not attained commercially in tubes made by other processes.

Since then, improvements have been made from time to time in process and product. The latest improvement, recently announced, entailed an expenditure of thousands of dollars for the latest-type controlled atmosphere electric bright annealing furnace in which ELECTRUNITE Boiler Tubes are normalized at a temperature above 1650°F. without scale being formed. Thus the fine bright surface of the cold formed tube is preserved absolutely free of scale—yet truly normalized—producing exceptional uniformity in structure and ductility.

The increasing demand during these four years has at times presented production problems in meeting delivery dates on steadily growing orders—has necessitated the installation of additional machinery and a further expenditure of a half-million dollars for a new building for finishing operations and stock.

Today, the most modern machines are busy day and night turning out large quantities of ELECTRUNITE Boiler Tubes. Additional equipment is in process of installation. Boiler manufacturers, railroads, marine companies, power plants and industrial concerns are demanding better boiler tubes—and Steel and Tubes, Inc., is producing them.

If you have never used ELECTRUNITE Boiler Tubes, write for full information on how they will reduce your boiler costs.

SUBSIDIARY OF REPUBLIC STEEL CORPORATION

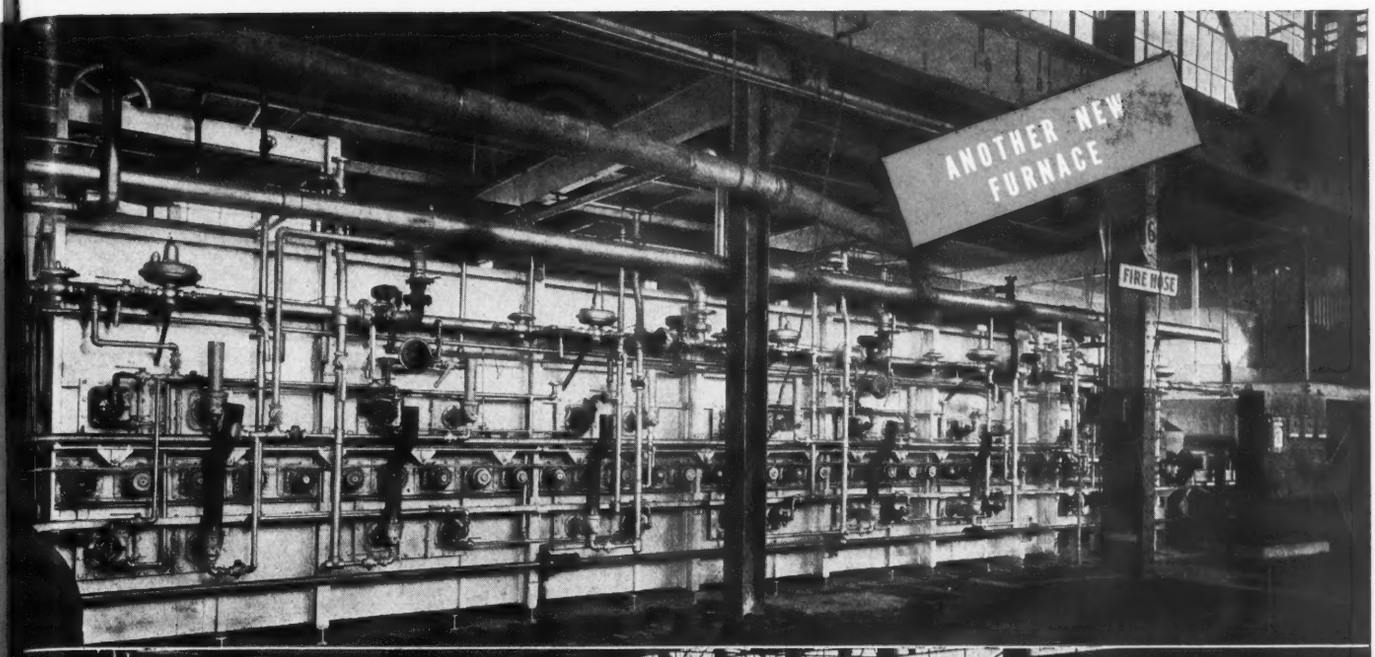
Steel and Tubes *Inc.*

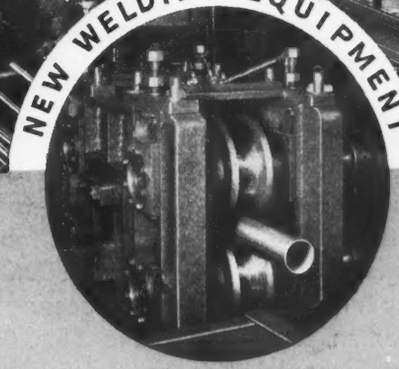
WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING

CLEVELAND . . . OHIO

. . . AND IN 1937

EVEN GREATER GROWTH





Again, it has been necessary to increase capacity to meet the rapidly growing demand for ELECTRUNITE Boiler Tubes. Another, larger, controlled atmosphere annealing furnace has been added. The end of the finishing building built in 1936 has been removed and the building increased in length. New welding equipment has been installed. And even with this increase in capacity, every unit must operate at full time to keep pace with orders.

There must be a reason . . . and this is it: Only by cold forming, electric resistance welding and controlled atmosphere annealing is it possible to produce boiler tubes with the unequaled consistent uniformity that makes ELECTRUNITE Boiler Tubes safe, sound and economical.

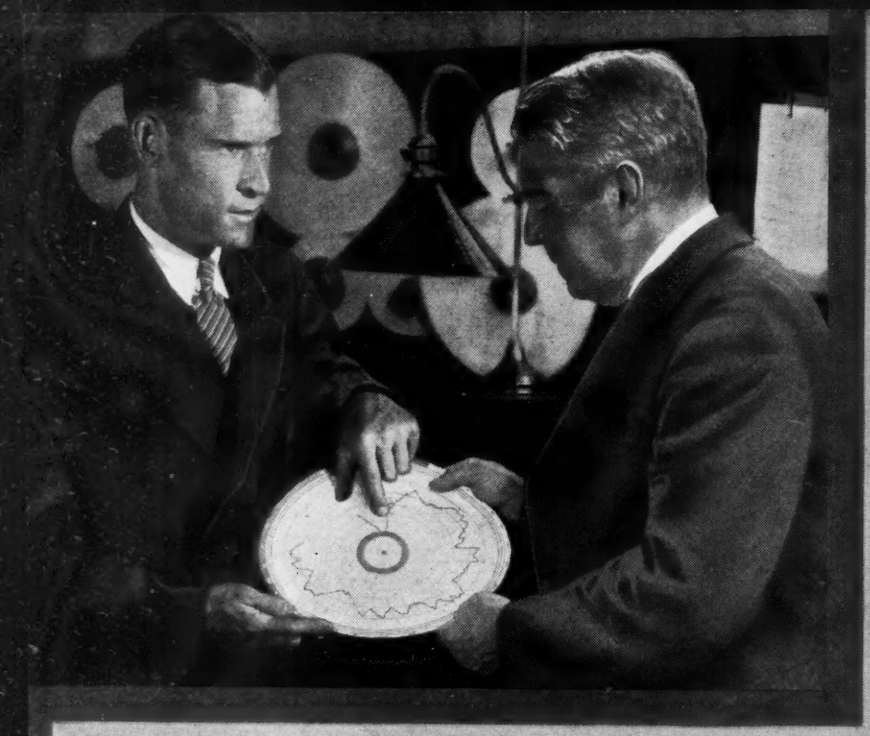
Let us tell you more about ELECTRUNITE Boiler, Condenser, Heat Exchanger and Air Preheater Tubes.

SUBSIDIARY OF
REPUBLIC
STEEL
CORPORATION

Steel and Tubes, *Inc.*

WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING

CLEVELAND . . . . OHIO



WHAT *You make* but HOW

MOST companies today require their Cost Analysts to determine the definite cost of each operation—in each department—yet, many of them arrive at their steam costs by simply dividing the total cost of steam for plant operation by the number of departments.

This method of determining steam costs in many plants has led to false operating efficiency because it has been definitely proven that the quantity of steam used not only directly affects the cost of processing per unit of product, but, in some cases, the quality of output.

For example:—A nationally-known manufacturer of molded products installed Brown Flow Meters on departmental steam lines—to the surprise of the plant officials, it was found that Power Engineer "A" was saving $500.00 worth of steam per month. In the processing department, Foreman "B" was wasting $500.00 worth of steam per month. On the books, the waste cancelled the savings.

Investigation showed that the processing operators had habitually neglected to close the steam valves properly. As a result, Power Engineer "A" was not getting credit for saving fuel. This careless waste of steam meant a net loss of $1000 to this company.

Too often, however, the power engineer's services end when he produces steam economically. What happens to it after it leaves the boiler—how efficiently steam is used is just as important as efficiency in the power plant proper.

And who is better equipped than the power engineer to determine how much steam is needed and at what pressure for a given processing operation? Or how much water and at what temperature?

Who is better equipped to sit down with the process engineer and show him the value of recording flow meters in improving manufacturing methods and reducing production costs?

Hidden leaks may be running into thousands

BROWN FLOW

MINNEAPOLIS-HONEYWELL . . .

To Measure and

ABOUT STEAM?

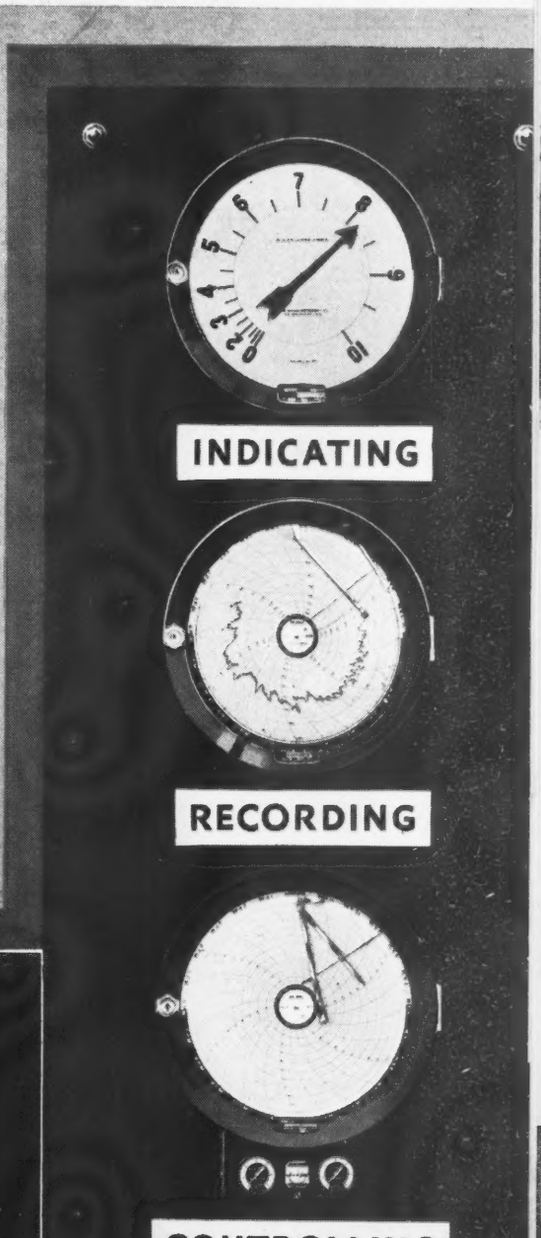
it economically . . . . .

IS IT USED in the plant?

of dollars in your plant unless the steam used in each department is separately recorded. Steam records for each department make it impossible for this important loss to escape detection. They tell where the steam is used, when it was used, just how many pounds were used during any part of the 24 hours.

With Brown Flow Meters, Indicating, Recording and Controlling your steam generation and distribution, you can obtain these detailed steam records Automatically.

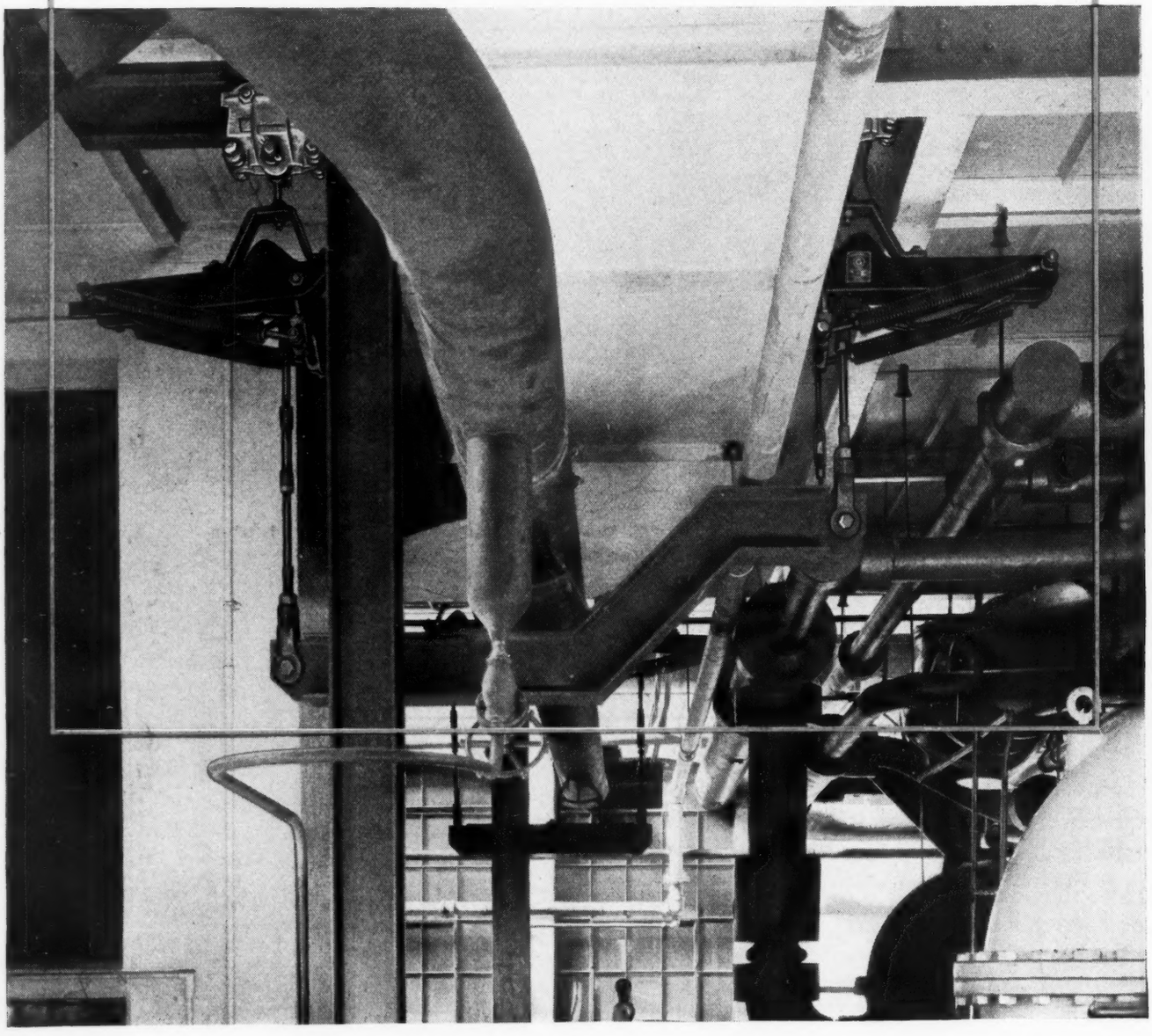
We should like to talk with both power and process engineers about steam costs in processing operations —show how Brown Flow Meters can carry into manufacturing many of the economies they have effected in power production. Brown Engineers will gladly undertake to prove the point. Write for Catalog No. 2005. —THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Penna. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland: Wijdesteeg 4—London, England: 70 St. Thomas' Street, S.E.1.

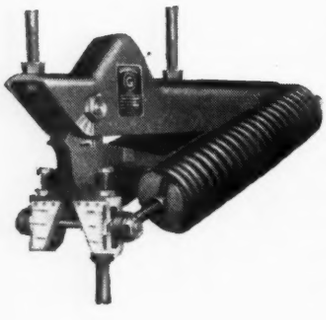


METERS
CONTROL SYSTEMS

Control is to Economize

"The Installation is as good as its Hangers"





No matter how much engineering genius is involved in the development of a prefabricated piping installation, that installation is only "as good as its hangers" — it must be free to float — to expand and contract in any direction. . . .

That is why the same engineering skill and experience that brought Grinnell Prefabrication into the lead built equal efficiency into Grinnell Genspring Constant Support Pipe Hanger.

The Genspring Hanger affords constant, adequate support throughout the entire range of the pipe's vertical and horizontal movement. Thus it adds another reason to the many that prompt leading users of prefabricated piping to say "Give the plans to Grinnell!" Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

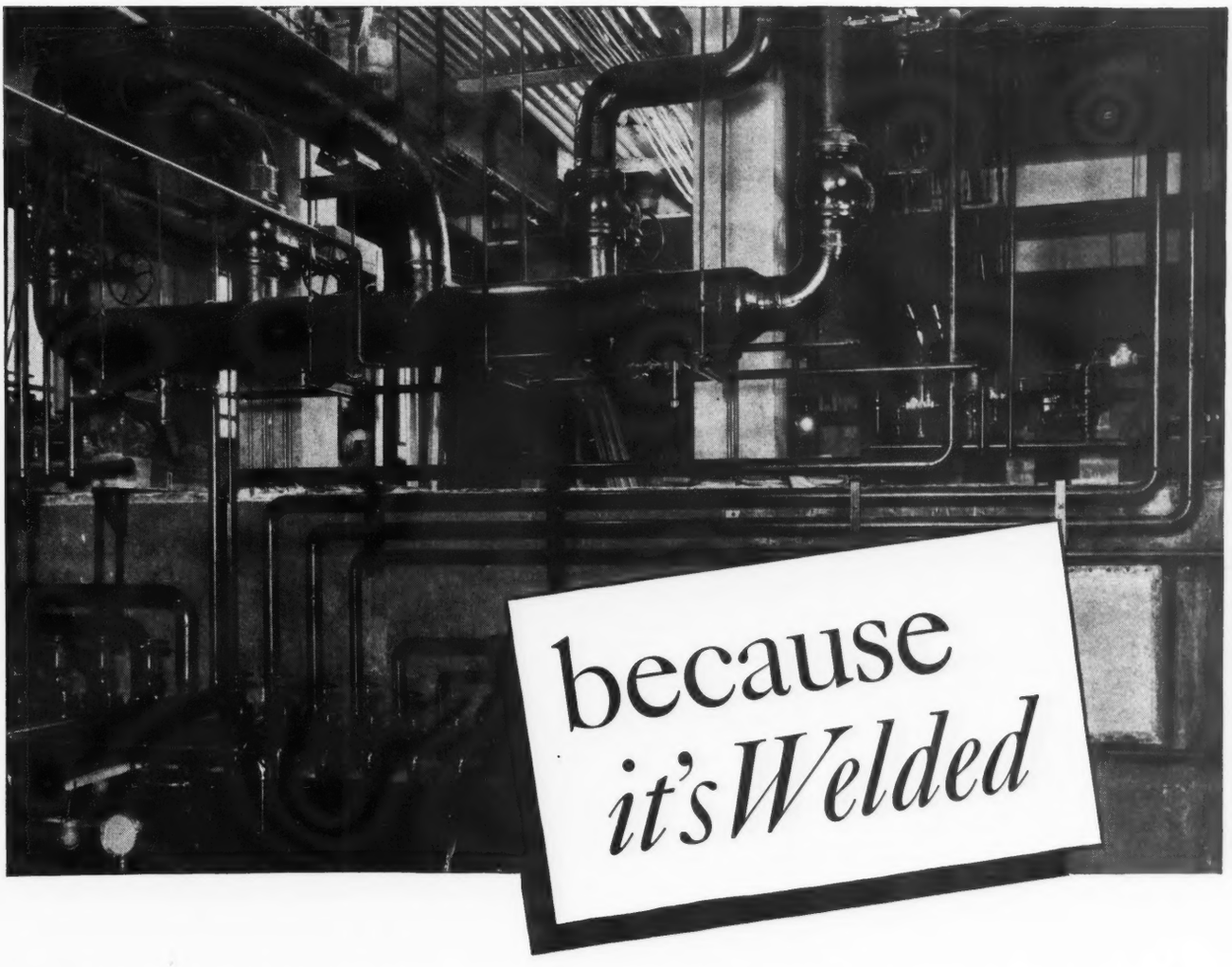
PREFABRICATION IN PICTURES

Send for this booklet — you'll find many worthwhile illustrations of complicated and routine power and process installations by Grinnell.

PREFABRICATION AND FITTINGS BY GRINNELL

WHENEVER PIPING IS INVOLVED

A compact installation



THE use of oxy-acetylene welding has made this piping installation much more compact than would have been possible with any other method of construction. Only with welding could such an intricate system of pipes be so closely nested to conform with the space limitations.

The installation of any piping system is greatly simplified when oxy-acetylene welding is used for joining the pipes and fittings. With this method of construction, the operator can obtain welds that are unusually ductile and that are as strong, dependable and corrosion-resistant as the pipe base metal. These advantages of welding are obtainable at no additional expense or time for installation.

Linde engineers have accumulated a wealth of practical experience and knowledge in the design and fabrication of industrial and building piping. Their help is available to assist you in every step of the planning and organizing of welded piping projects. Ask the nearest Linde office for full information concerning this valuable service and how you may obtain a copy of the useful 200-page book "Design of Welded Piping." The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM LINDE UNION CARBIDE

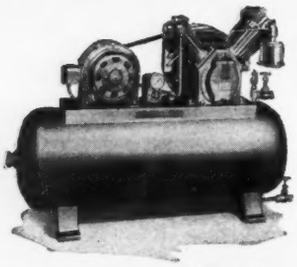
PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION

What size Compressor do you need?

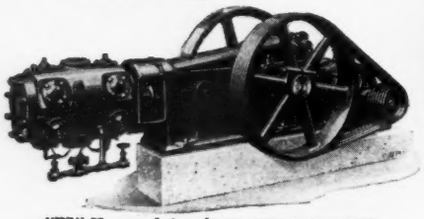
Is it for AIR or GAS?

What is the PRESSURE?

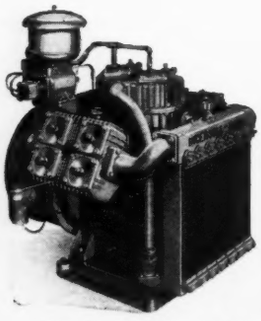
What kind of SERVICE?



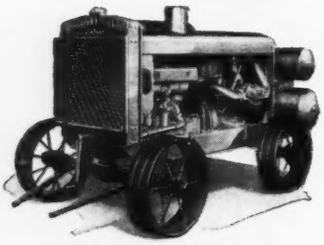
T-30 Self-contained air-cooled compressor. Sizes ¼ to 15 hp. Pressure to 1000 lbs. and vacuums.



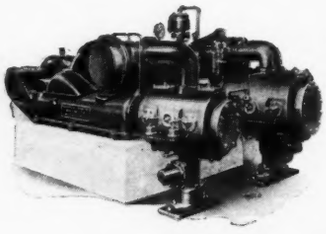
"ES" Heavy-duty air or gas compressor. Pressures 5 to 3000 lbs. and vacuums. Sizes 5 to 125 hp. Also for steam drive.



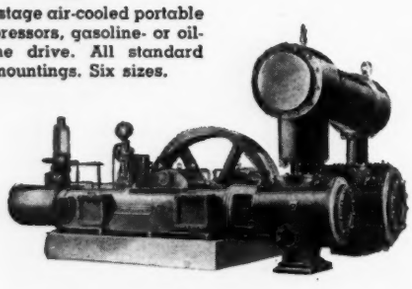
Two-stage air-cooled Motor-compressor. 80 to 125 lbs. pressure. 15 to 75 hp.



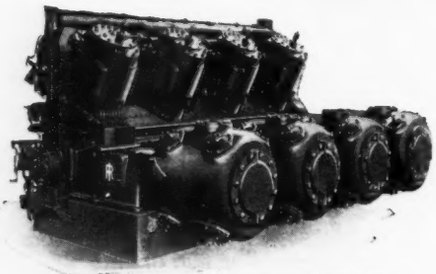
Two-stage air-cooled portable compressors, gasoline- or oil-engine drive. All standard mountings. Six sizes.



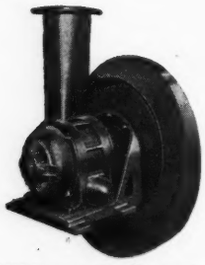
Duplex single- or multi-stage. Belted or direct-connected drive. Sizes 50 to 250 hp. Pressures up to 5000 lbs. and vacuums.



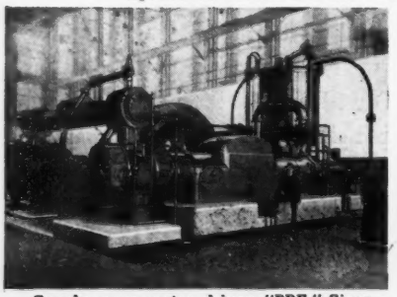
"XPV" Steam-driven compressor unit. Sizes 50 to 1500 hp. Pressures up to 5000 lbs. and vacuums.



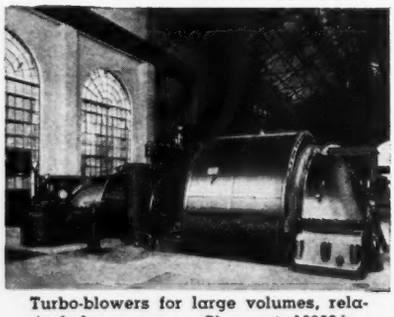
"XVG" with built-in gas-engine drive. "XVO" for oil drive. Sizes 60 to 300 hp. Pressures from 5 to 5000 lbs.



"FS" and "CS" single-stage centrifugal blowers. 73 sizes from 5 to 125 hp. Pressures from ¾ to 3 lbs.



Synchronous-motor-driven "PRE." Sizes 200 to 3000 hp. Pressures 5 to 5000 lbs.



Turbo-blowers for large volumes, relatively low pressures. Sizes up to 12000 hp.

There is an Ingersoll-Rand Compressor for Every Condition

THE variety of types of Compressors shown on this page is not the result of an inventor's idle dream. On the contrary, each is a standard type which was pioneered by Ingersoll-Rand after years of concentrated development work and close association with the field problems involved.

Each type is designed to economically meet some particular kind of service better than any other type; to provide electric-motor, steam, belt, oil-engine, or gas-engine drive. Some types are strictly air compressors; others handle gases of practically every description.

There are those for the permanent, stationary installation; stationary units incorporating features for easy relocation; and highly portable units for the transient job.

Each type is built in a complete range of sizes. In fact, the whole field of compressor needs, ranging from vacuums to 5,000 lbs. per sq. in. pressure and sizes from ¼ to 12,000 hp., is covered by the Ingersoll-Rand line.

When you need a compressor there is a 100 to 1 chance that you can choose a standard I-R machine or that Ingersoll-Rand has at some time or other built a unit to meet similar conditions. If your job is the exception, the combined experience of a trained engineering corps, employed by the largest compressor builder in the world, is ready to help you solve your problems.

The I-R line also includes air-operated tools, Cameron Pumps, Diesels, Condensers and Refrigerating Units.

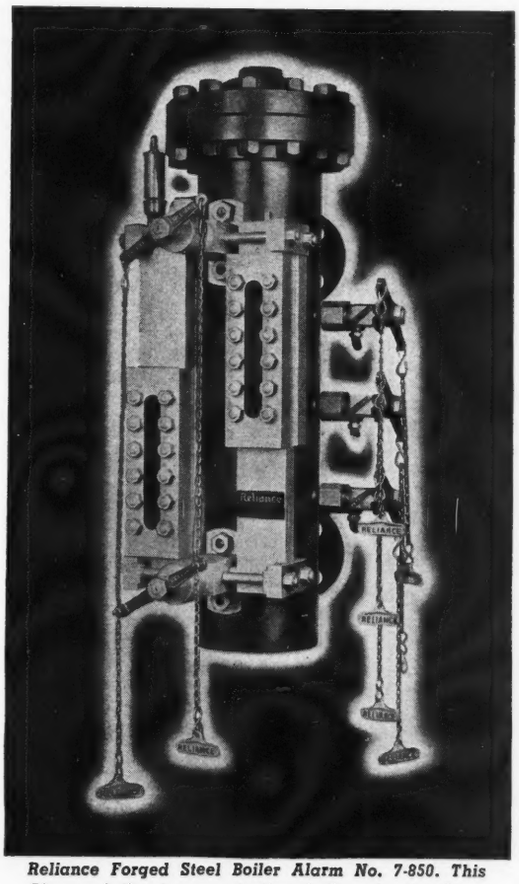
Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Knoxville, Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

3804-1

Quick AS A FLASH!



Reliance Forged Steel Boiler Alarm No. 7-850. This Alarm of the type protecting boilers in the River Power House of The Radio Corp. of America (RCA) at Camden, N. J.—and many other modern plants. Shown are Reliance gage cocks and water gages for 2000 pounds pressure.

Reliance Alarms Act to Keep Your Boilers Safe

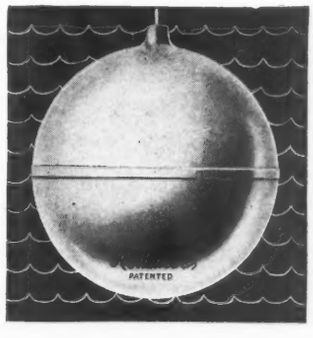
—and power production uninterrupted

When your boiler pressures are chummy with 900 pounds, absolute certainty that there's plenty of water becomes a life-and-death matter. Plenty of water and the boiler is 99-98/100 safe—run short of water and it may be news you never have a chance to read.

This Reliance Forged Steel Boiler Alarm removes the risk. Built of the most modern materials that test at twice your working pressure, its simple direct mechanism, guaranteed by unsinkable stainless floats, gives you the comforting assurance of instantaneous reaction to changing water levels—the shrill whistle or electric alarm flash the warning, compel instant attention.

Follow the wise lead of thousands of power plant engineers—protect your life, your plant and the efficient uninterrupted power for which you are responsible with Reliance High Pressure Alarms. For 53 years not one has been known to fail in an emergency.

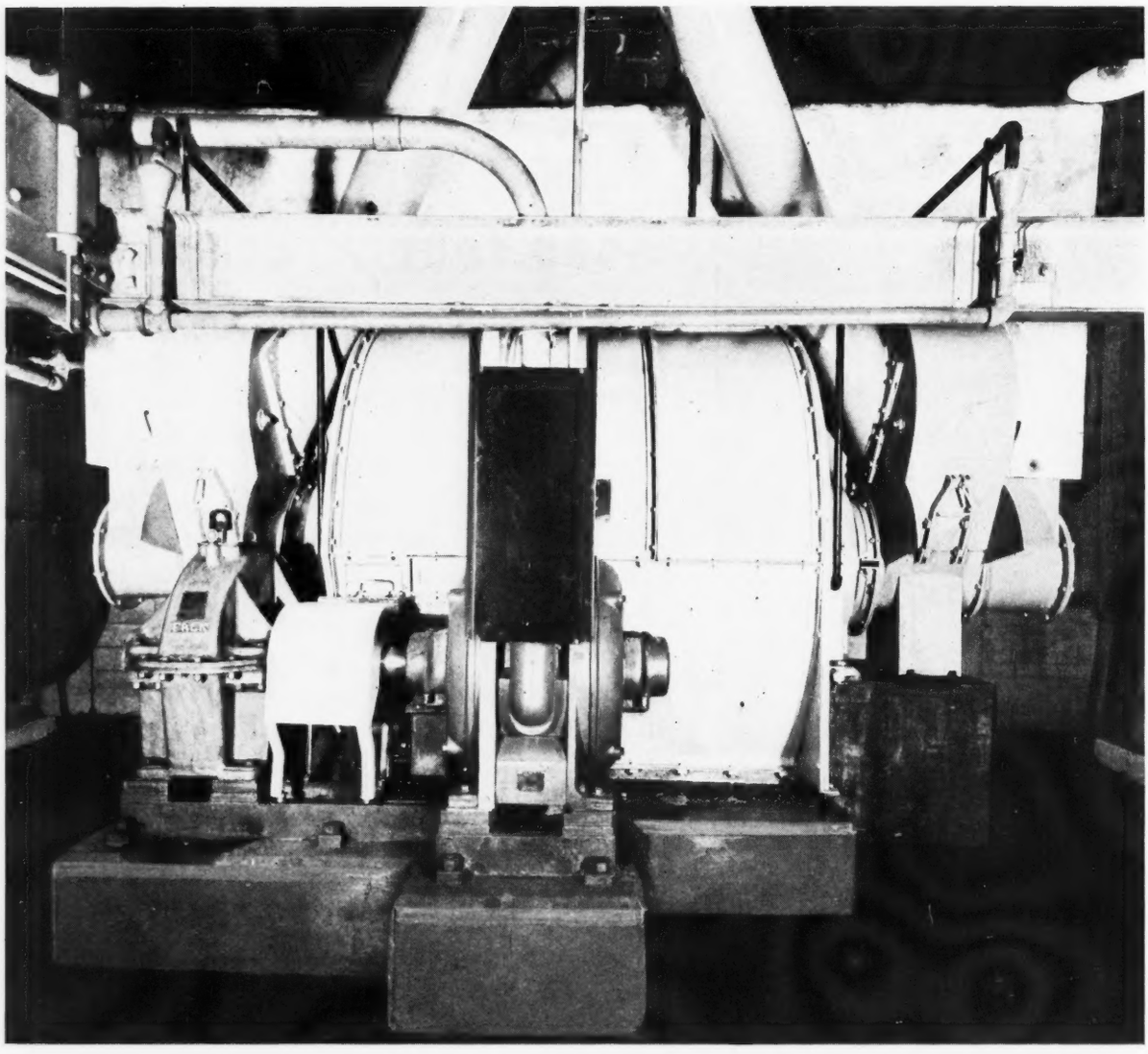
Write today.



Made of stainless metal, this Reliance float is highly buoyant, powerful, guaranteed against failure in its service.

The Reliance Gauge Column Co.
5902 Carnegie Ave., Cleveland, Ohio

Double Classifier
Conical Ball Mills



High Availability
Minimum Maintenance

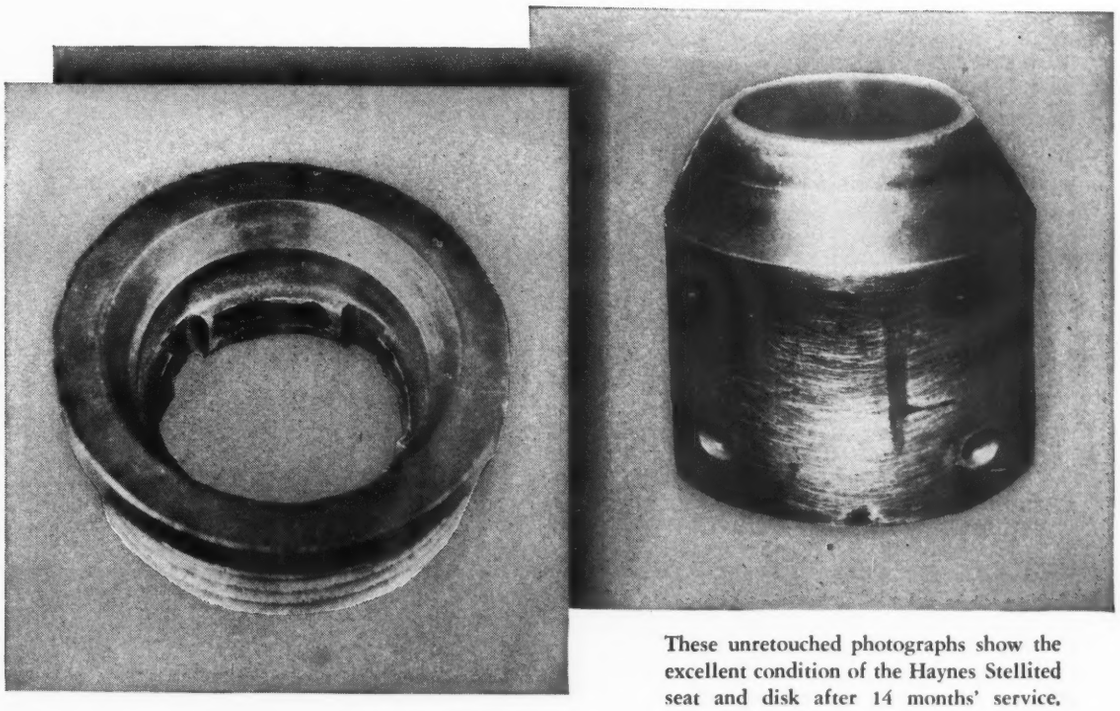
The application of double classifiers has increased the capacity and raised the efficiency of the outstanding pulverizer for heavy duty and difficult fuels. Six of these mills have fired three 130,000 lb. per hour boilers for five years — 43,800 hours of service—without shut down for repairs. Pulverizing surfaces (inexpensive steel balls) are fed into the mill without interrupting the preparation of fuel. Conical ball mills provide the flexibility to follow sharp variations in load instantaneously, due to the reserve fuel supply always available.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK, N. Y.

FOSTER WHEELER

Haynes Stelliting
SAVES 20 Costly Valve Replacements



These unretouched photographs show the excellent condition of the Haynes Stellited seat and disk after 14 months' service.

• These parts of a ¾-inch Haynes Stellited globe valve showed no signs of scoring or wire-drawing after operating continuously for 14 months at 460 pounds pressure in a steam superheater line. This performance is particularly significant because the valve was used for drip service where valves formerly had to be replaced every three weeks. Thus, 20 costly replacements were saved by applying Haynes Stellite to this one valve.

Such performance records explain why progressive power plants everywhere are using valves with Haynes Stellited seating surfaces. Are *you* availing yourself of these economies?

New valves wearproofed with Haynes Stellite are available from most of the valve manufacturers.... Write for the booklet, "Haynes Stellited Valves", which describes other interesting performance records.

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

HAYNES STELLITE TRADE MARK

A red-hard, wear-resisting alloy of Cobalt, Chromium and Tungsten

HAYNES STELLITE COMPANY

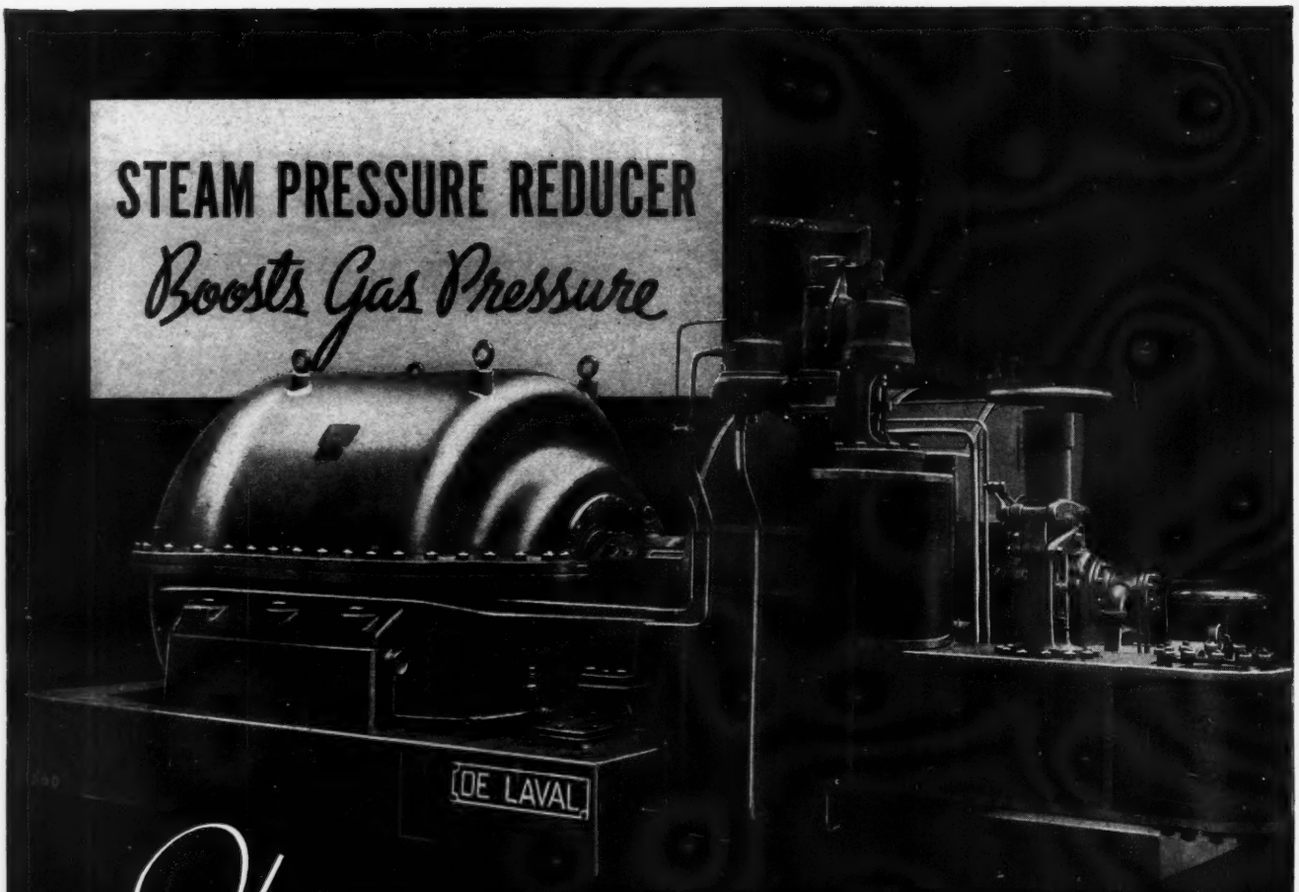
Unit of Union Carbide and Carbon Corporation

UCC

Chicago · Cleveland · Detroit · Houston · Los Angeles · New York · San Francisco · Tulsa

General Office and Works—Kokomo, Indiana
Foreign Sales Department—New York City

Haynes Stellite Welding Rods and information on other Haynes Stellite Products also are available through the 46 apparatus shipping points of The Linde Air Products Company



This DE LAVAL STEAM TURBINE

in expanding process steam from 125 lb. to 10 lb. per sq. in., develops 810 hp.

●

THE DE LAVAL FIVE-STAGE BLOWER

which it drives at 4000 r.p.m. raises 16,700 cu. ft. per min. of 0.62 gravity gas from atmospheric pressure to 10 lb. per sq. in. ● The fuel cost of this 810 hp. is small indeed, as the turbine removes from the steam only the heat actually converted into shaft horsepower; in other words, about 2545 Btu., per hp. instead of the 9000 to 12,000 Btu. taken by a condensing turbine. ● Industrial plants offer many opportunities for producing low cost power from steam used at low pressure. Where turbines or engines are already installed, similar economies are gained by superposing a high pressure boiler and turbine, the latter exhausting into the existing steam mains.

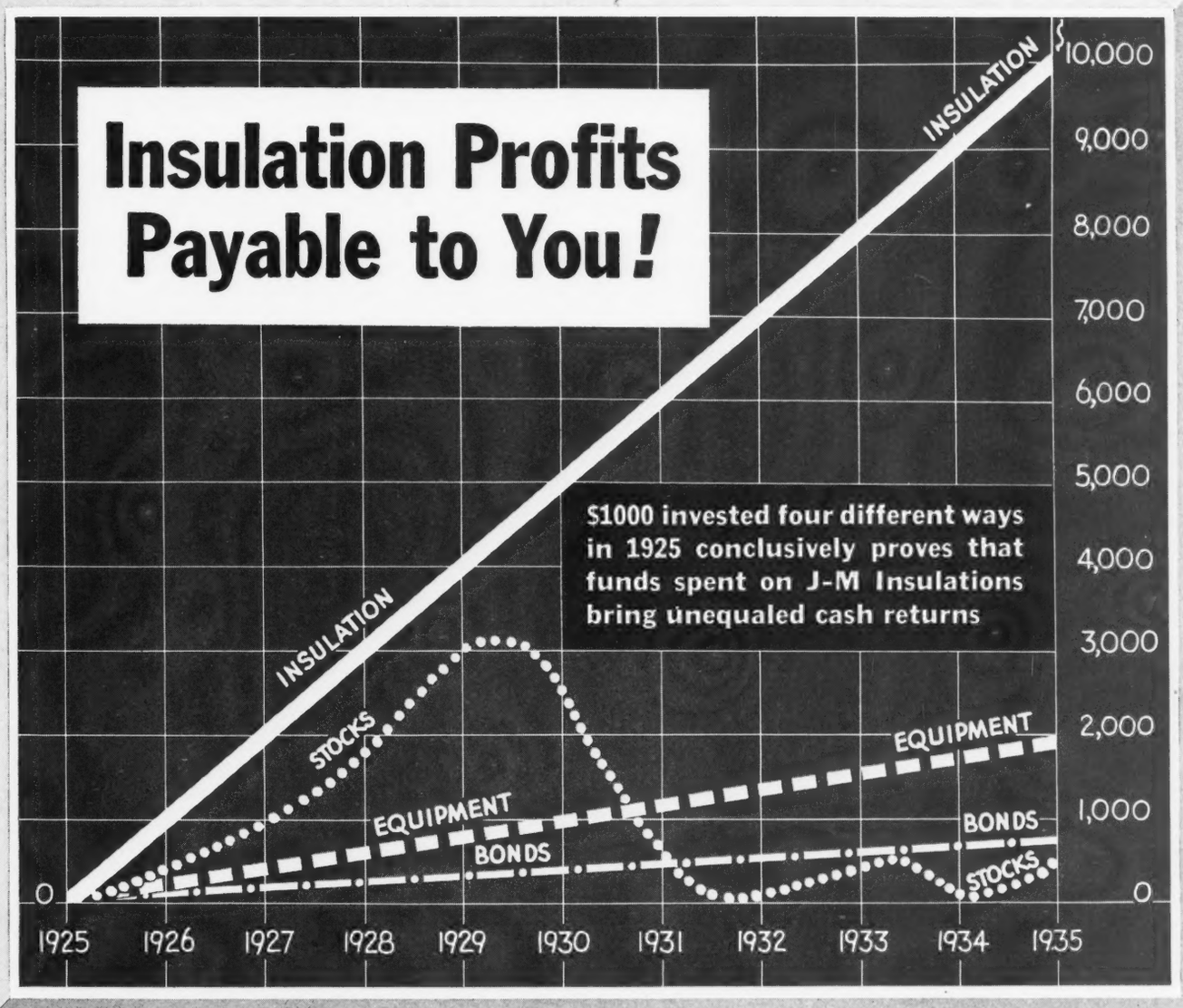
✓ **DATA ON POWER UNITS**

for various conditions which will enable you to prepare accurate estimates of savings will be supplied upon request

3503

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS—CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, CENTRIFUGAL BLOWERS AND COMPRESSORS, WORM GEARS, HELICAL GEARS, HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS • • • SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM



STOCKS . . . mortgage bonds . . . mechanical equipment . . . contrast their investment returns with that of J-M Insulations. Here's the black and white record:

One dollar each year . . . for every dollar originally invested in Johns-Manville Insulations! Thus, in ten years, $10,000 on every thousand!

And not in isolated cases, either. Based on the performance reports of a wide variety of J-M Insulations . . . in every type of plant . . . this is a record you, too, can duplicate.

Are you sure your boilers, steam lines and other heated equipment are now adequately insulated? That you are not overlooking opportunities for similar profits?

Why not make sure by calling upon a J-M Insulation Engineer for a check-up in your plant? With 79 years of research and practical experience to draw upon, they can estimate the insulation profits that should be yours with amazing accuracy.

And they can specify the right J-M Insulation for assuring these dividends with similar certainty. For Johns-Manville makes some 40 different kinds of insulation in every desired thickness. And each of these materials has an established record for providing maximum returns on the equipment for which it is designed. Johns-Manville, 22 East 40th St., N. Y. C.

JM PRODUCTS

Johns-Manville INDUSTRIAL INSULATIONS

An insulating material for every temperature . . . for every service condition

After More Than 35 Years . . .

Genuine Squires Steam Traps and Steam Specialties are still a "Standard" in the Power Field

Squires steam, air and blast traps—reducing valves—pump governors—feed water controllers—have been a standard of reliability for more than 35 years.

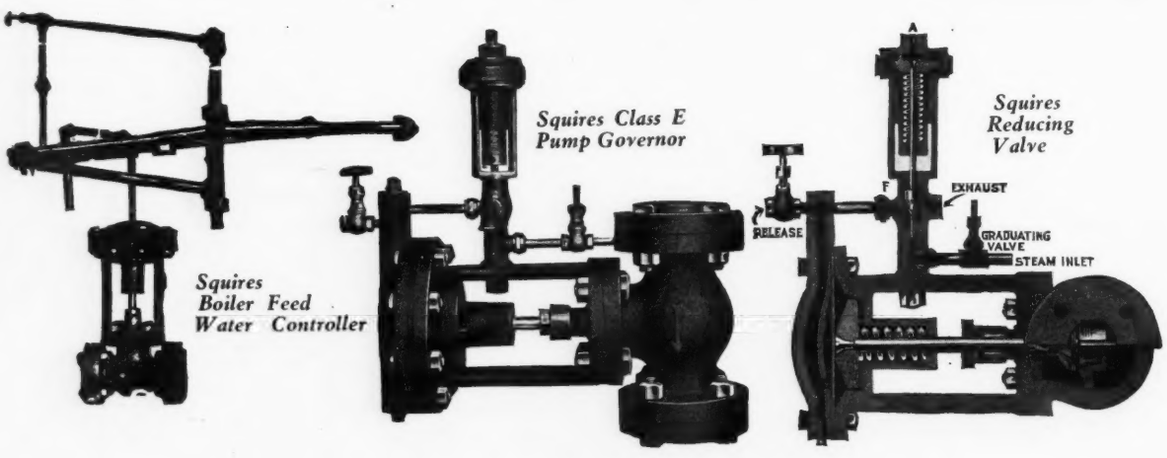
Today, more than ever, Squires traps and steam specialties stand out as simple, durable, economical, efficient devices upon which the engineer can rely.

Leading companies everywhere use Genuine Squires Traps, because the same good principles that made them reliable have not been deviated from. Note how easily and quickly a valve and seat may be replaced for any other desired pressure.

Squires Reducing Valves will reduce from any pressure to atmospheric in one reduction. No need of secondary valves. They are dead end valves.

Write for literature A-1.

THE C. E. SQUIRES CO.
EAST 40TH STREET & KELLEY AVE.
CLEVELAND, OHIO

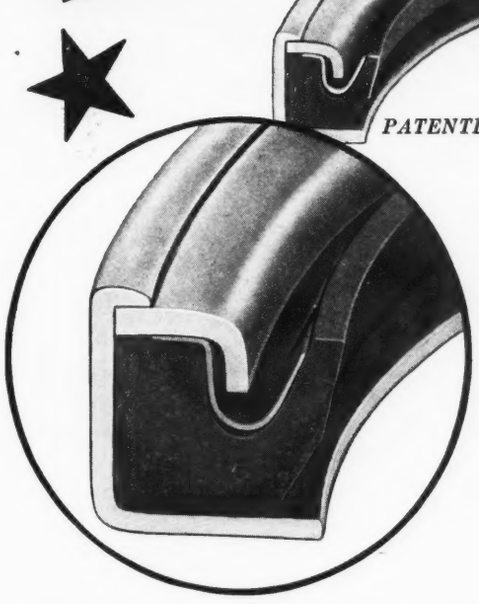


Insist on the Genuine Squires

Steam Specialties

THE C.E. SQUIRES COMPANY — E.40TH ST. & KELLEY AVE., CLEVELAND

THE MODERN OIL SEAL



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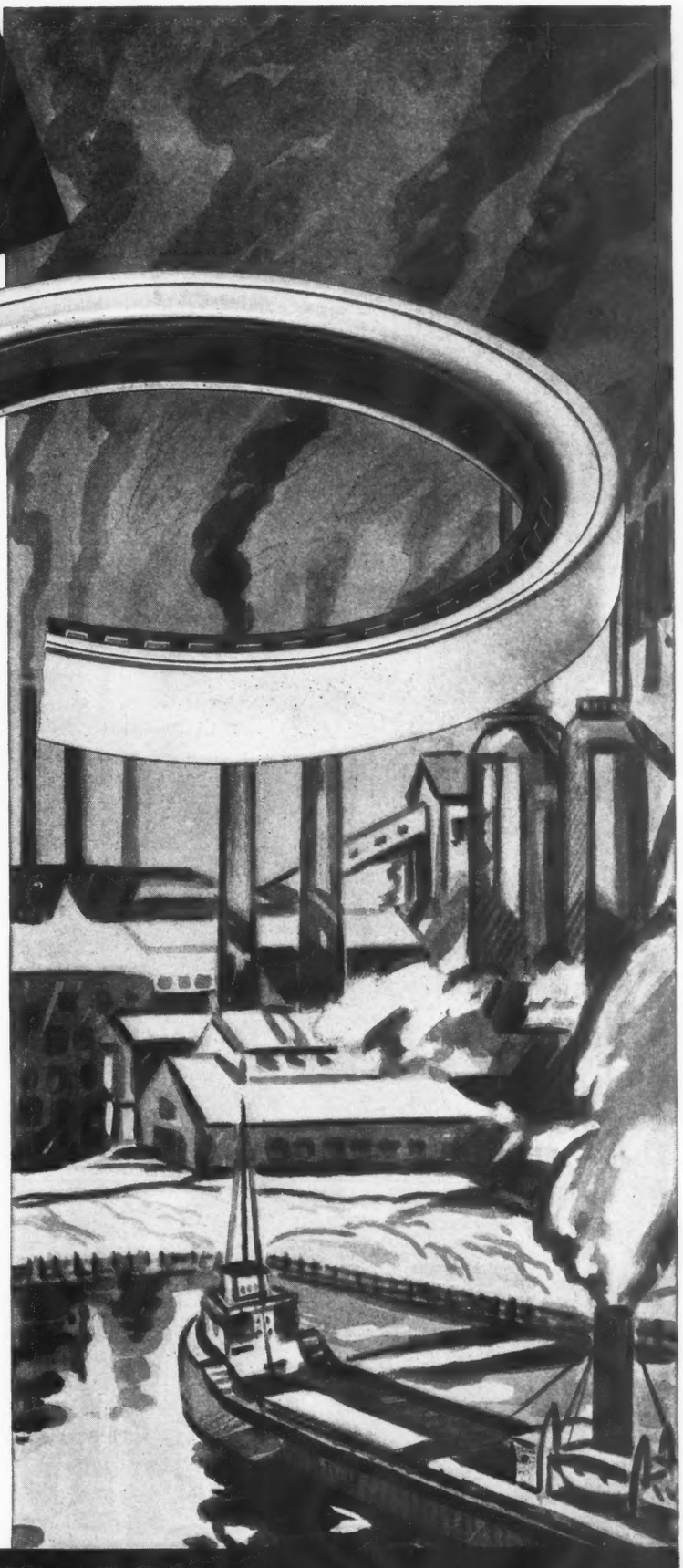


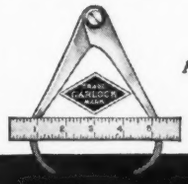
ADOPTED BY INDUSTRY THROUGHOUT THE WORLD

THOUSANDS of orders from all parts of the world—totaling literally millions of KLOZURE Oil Seals—are evidence of the superiority of the GARLOCK KLOZURE. The sealing element is made of a special compound which is dense, grainless, tough, resilient—resists oil, heat and wear. Complete range of sizes. Write for catalog!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Que.

1887-1937



50th ANNIVERSARY

Garlock KLOZURE

Guaranteed Performance

Created--

To meet the demands of a rapidly expanding process for rebuilding and reconditioning mechanical equipment efficiently, comes this instrument of fine precision by Stevens.

- *Speedy*
- *Rugged*
- *Compact*

4

EXCLUSIVE FEATURES:

High capacity nozzle » » Automatic Wire Feed Device » » Gear Shift Assembly 800-1. . . to 1600-1. "No Gear Change Required." Mechanical Assembly readily removable for Inspection. Ball Bearing Mounted and Self-Lubricated.

For Catalog 14P

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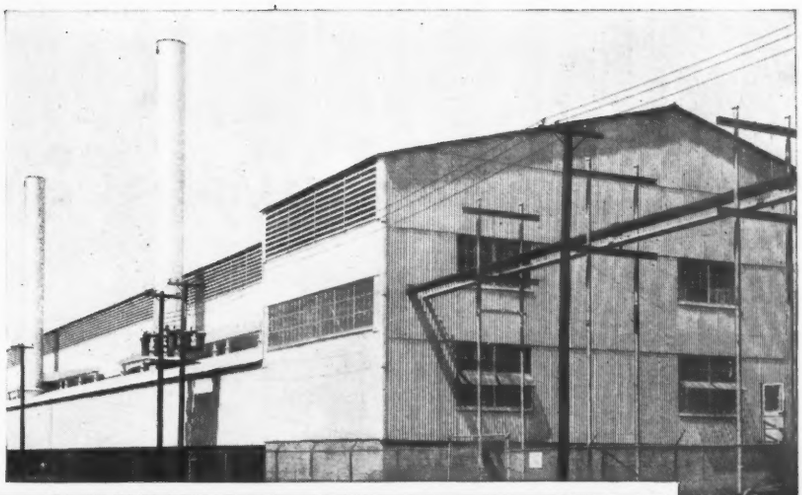
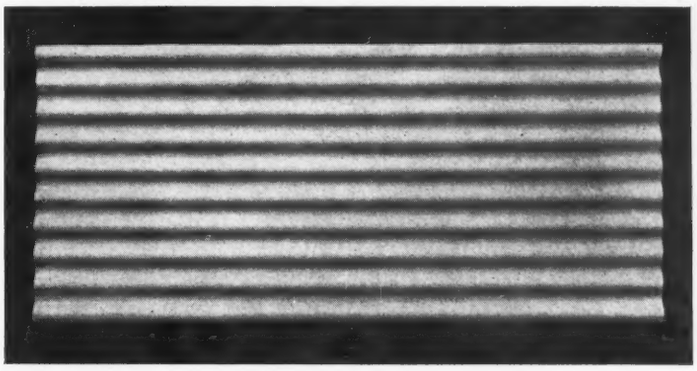
STEVENS METAL SPRAYING, INC.
81-83 SHIPLEY STREET, SAN FRANCISCO, CALIF.

Fire-resisting . . . . . it lasts almost forever



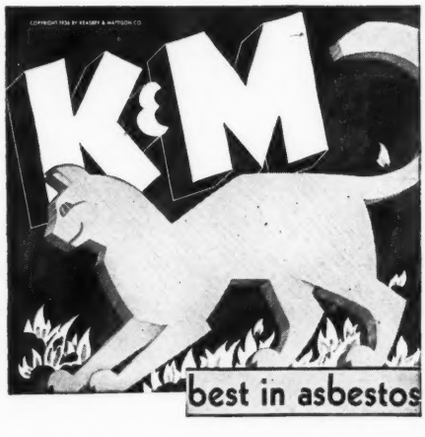


K&M

CORRUGATED ASBESTOS

K&M Corrugated Asbestos—made of asbestos fibre and Portland cement under enormous pressure—is a strong, dense, tough sheet, fire-resisting and weather-resisting. Corrugations give it greatly increased strength, and help in obtaining correct alignment, resulting in water-tight joints.

It is used to great advantage for roofing, siding and partitions in skeleton-frame industrial building, for storehouses, lumber mills, wood working plants, cooling towers, power houses. Like all K & M products, it has exceptional durability and uniformity. Behind these products is more than 60 years of experience in the development of asbestos and magnesia materials of all kinds.



Send for information

"Featherweight" 85% Magnesia Pipe Insulation, Blocks and Lagging • Asbestos Pipe Insulation in sections • Asbestos Insulation in sheets and blocks • Asbestos Insulating Cements • Asbestos Packings: rope, cord, and sheet • Asbestos Gaskets, Gasket Tapes and Cloth • Friction Materials • Refractory Cements, dry and plastic • Asbestos-Cement Sheets in corrugated and flat form.

Underline the products on which you want full information and mail this coupon today.

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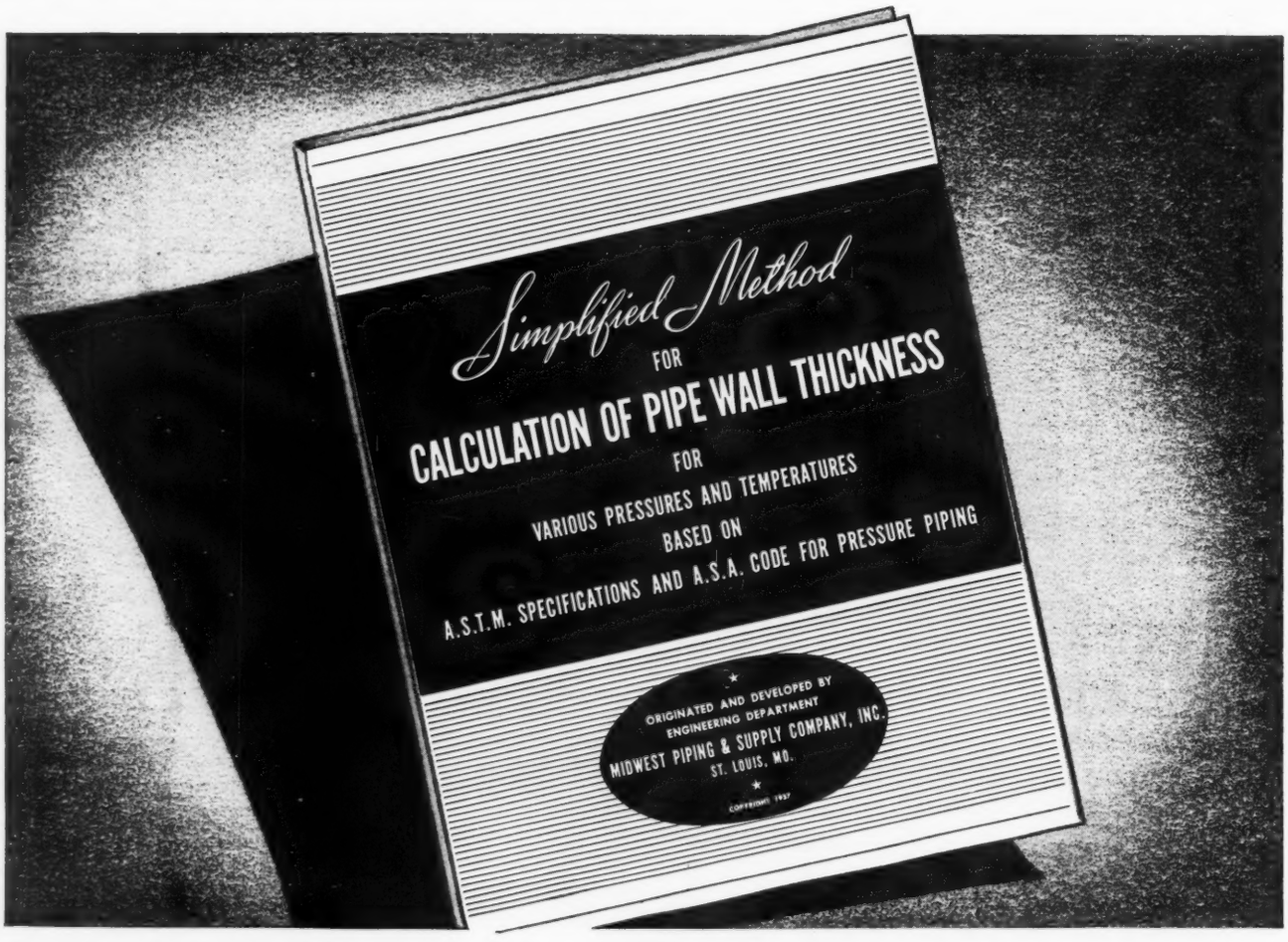
KEASBEY & MATTISON COMPANY
AMBLER, PENNA.

A NEW TECHNICAL BULLETIN

that piping designers will appreciate



Now you can determine required pipe wall thicknesses by simple and quick reference to a chart . . . no substitution in formulae . . . no extensive calculations . . . no need to refer to A.S.T.M. Specifications or the A.S.A. Code for Pressure Piping.

This bulletin will gladly be sent to anyone interested who requests it upon a business letterhead. Simply mention Bulletin 37-A and address the main office at St. Louis.

TYPICAL PROBLEMS

Q. What should be the wall thickness of 8″ seamless steel grade "A" pipe for 500 lb. W.S.P. at 650° F.?

A. .406″.

Q. What should be the wall thickness of 20″ O.D. lap welded pipe for cold gas at 240 lb. W.P.?

A. .375″.

Both of these answers were secured in less than two minutes by use of this bulletin.

Midwest Piping & Supply Company, Inc.

Piping Fabricators and Manufacturers of Pipe Welding Fittings

Main Office: 1450 So. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—1716 Second National Bank Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

CHRISTMAS GREETINGS

To all who are users of Pure Industrial products, we wish to express our appreciation for your business in the past and trust that our products and service will merit the continuance of our associations.

THREE PURE

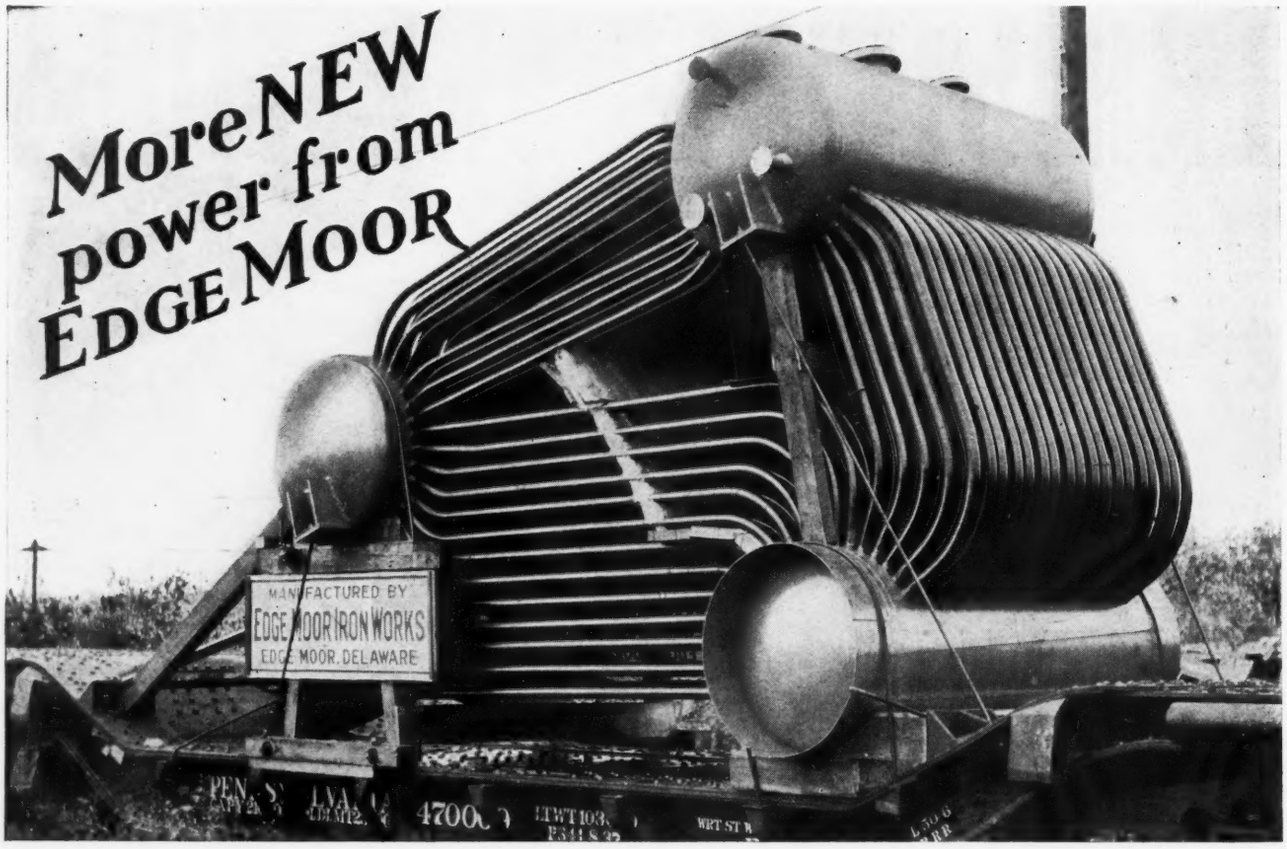
Comprising Pure Oil's Three Point Service is: 1) Selected Crude. 2) Skillful Refining and 3) Scientific Application.

To all who will become users of Pure Industrial Products in the year to come, we assure most careful consideration will be given your varied lubrication needs. Being of service to you is anticipated with pleasure.

THE PURE OIL CO.

U. S. A.

PRODUCERS, REFINERS, MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS



Edge Moor Low Head Boiler en route to a large chemical plant in the mid-west.

EDGE MOOR . . . on the way to a second 5000!

The trend to Edge Moor Boilers is an established fact. Look over the list of a few recent jobs. Note the horse power being installed, the types of plants, the national standing of the organizations represented.

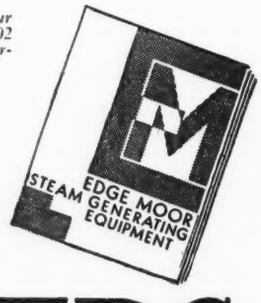
There are good reasons for this ever-growing acceptance. Consistently high fuel economy and low maintenance over a period of years in plants all over the world—present day high standards in design and construction—advanced engineering—these and many other factors contribute to the fact that as more horse power is required, Edge Moor Boilers are specified and installed.

It will pay you to get all the facts.

RECENT EDGE MOOR BOILER INSTALLATIONS

City of Chicago	2515 h.p.
New Iberia Cooperative	2500 h.p.
Hercules Powder Company	2127 h.p.
Swift & Company	1370 h.p.
South Coast Corporation	1200 h.p.
Missouri Pacific R.R. Co.	1030 h.p.
Tide Water Power Co	813 h.p.
Sloane-Blabon Co.	800 h.p.
Albermarle Paper Mfg. Co.	661 h.p.
Worcester State Hospital	526 h.p.
City of Harrisonburg	507 h.p.
Village of Hinsdale	400 h.p.

Write for a copy of our new catalog No. 102 "Edgemoor Steam Generating Equipment"



EDGE MOOR Water Tube BOILERS

EDGE MOOR IRON WORKS, INC., 30 Rockefeller Plaza, New York

PRE-FABRICATED PIPING

1938

JANUARY

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A Handy* Calendar

* AND USEFUL TOO

AND a handy name to remember any day you need anything in Pre-Fabricated Piping, whether it be one header or a complete piping system. Our experience dates back to the days when central power stations were in their infancy and we have constantly kept pace with the latest requirements of pressures, temperatures, alloys and guarantees. (Our long list of satisfied customers proves both.) Any day that we can be of assistance with recommendations, quotations or prompt piping service, ask us to send an engineer or mail us your prints. The Benjamin F. Shaw Co., Wilmington, Del.

SHAWCO

POWER & INDUSTRIAL PIPING FABRICATORS & CONTRACTORS

Speed! Speed! Speed!

CRIES INDUSTRY

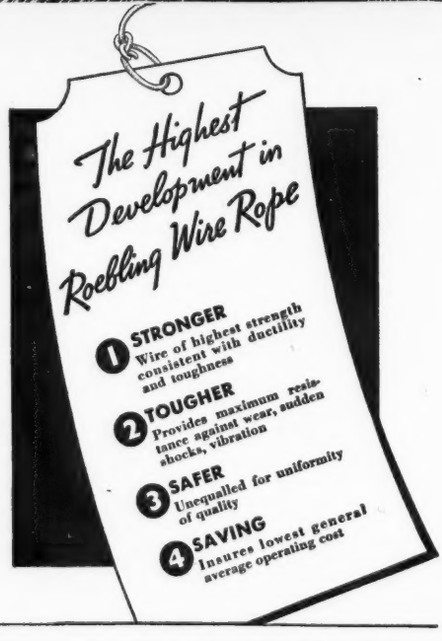
Today's severe demands on equipment call for utmost wire rope stamina

Industry must reduce costs—to make profits. More work from existing equipment—and faster.

Roebling "Blue Center" Steel Wire Rope has more than met these exceptionally severe requirements.

Roebling "Blue Center" combines the highest strength with the maximum resistance against fatigue and wear. For a wide variety of applications where service conditions are exceptionally severe, *it has proved conclusively that it assures lowest general average operating costs.*

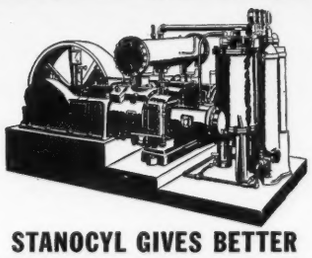
JOHN A. ROEBLING'S SONS CO., TRENTON, N. J. *Branches in Principal Cities*


The Highest Development in Roebling Wire Rope
1 STRONGER
Wire of highest strength consistent with ductility and toughness
2 TOUGHER
Provides maximum resistance against wear, sudden shocks, vibration
3 SAFER
Unequalled for uniformity of quality
4 SAVING
Insures lowest general average operating cost

ROEBLING ✸ BLUE CENTER

"Where's all your stock of lubes?"

"*That's all we need since they made that* LUBRICATION SURVEY!"



STANOCYL GIVES BETTER LUBRICATION AT LOWEST COST

In StanoCyl, the exact stocks and compounding materials have been chosen to give fast, complete atomization. This means that StanoCyl gives instant, uniform coverage of valves and cylinder walls for maximum protection against wear.

Cylinder stocks are also carefully refined to produce a cylinder oil with high heat resistance and exceptional cleanliness which assures complete protection against carbon formation and gummy deposits.

This better lubricating quality in StanoCyl has invariably brought a further *saving in oil consumption.*

There is a grade of StanoCyl exactly suited to your need. A Standard Lubrication Engineer will be glad to help you get the cost saving advantages of the grade you require.

Copr. 1937, Standard Oil Co.

A THOROUGH, scientific examination of your lubrication requirements by a Standard Lubrication Engineer will show *many* ways in which you can save money, particularly on your stock of lubricants.

Complicated lubricant stocks are hard to handle and dispense, and confusing to stock clerks and oilers alike. As a result of this confusion, lubrication recommendations are frequently ignored, definitely contributing to higher maintenance and lubricating costs.

A lubrication survey in your plant may show many instances in which one lubricant can replace three or four brands now carried. The saving this means is evident: reduced stock, less waste, less handling and lubricating time, and above all, full assurance of the right lubricant for every job.

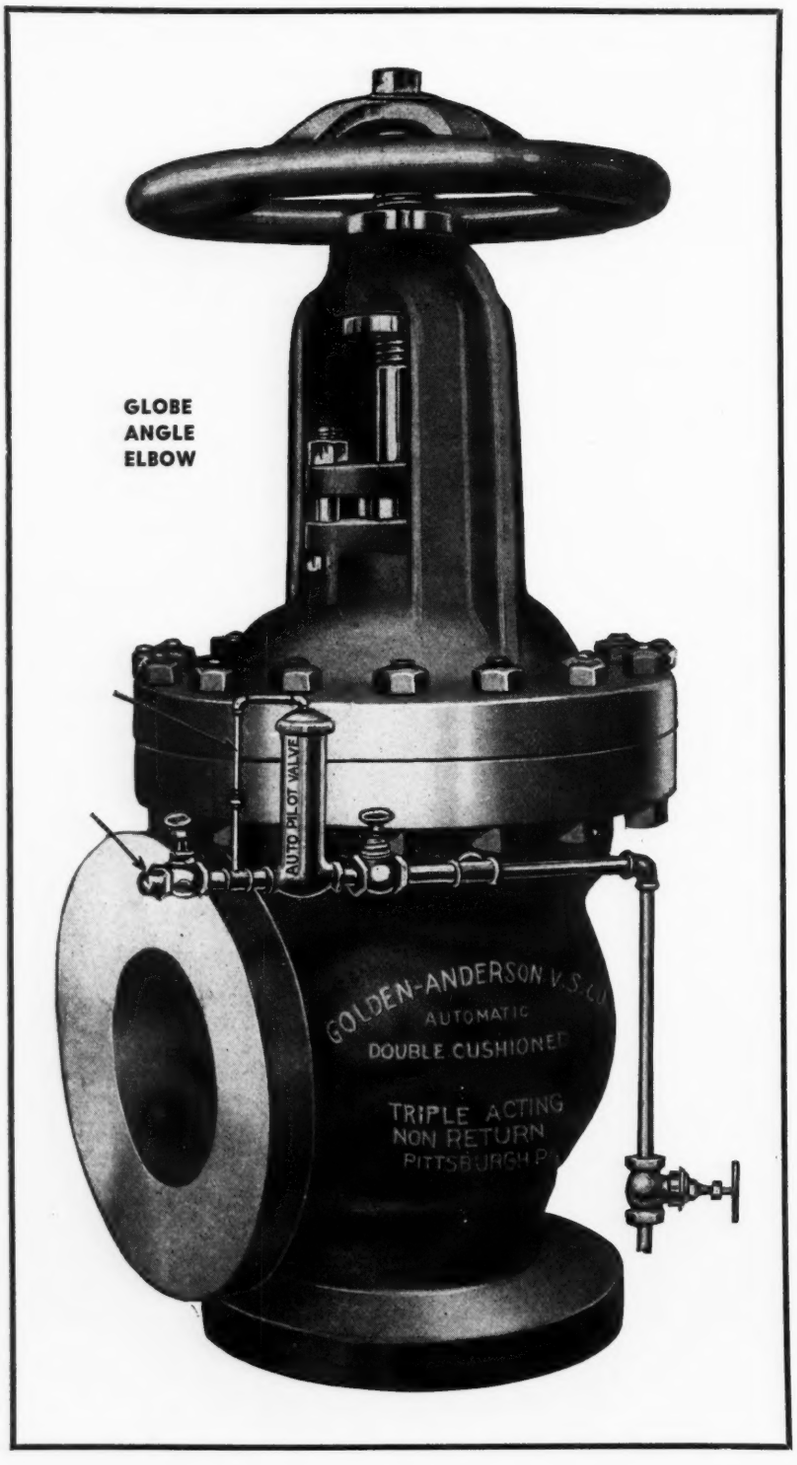
Call the Lubrication Engineer at your local Standard Oil (Indiana) office. Let him tell you *how* a lubrication survey can bring about further cost reduction in your own plant. There's no obligation. Make an appointment with him today.

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING

Four Outstanding Contributions



GOLDEN-ANDERSON Triple-Acting Non-Return Valve

Probably no other valve ever built has the universal acclaim of power engineers. Thousands are in use today. Note the "ten reasons why":

1. **Automatically cut out the boiler the instant that a tube rupture or other internal break occurs.**
2. **Automatically cut off the steam flow from every boiler the instant that a steam pipe breaks.**
3. **Automatically equalize the pressure between all boilers.**
4. **Automatically cut in a boiler making accidents due to inaccurate steam guage impossible.**
5. **Positively prevent backflow of steam into a cold boiler.**
6. **Can be closed by hand, like ordinary stop valve, and arranged with "combination feature" to open valve like regular gate and globe valve.**
7. **Can be tested in service from boiler room floor.**
8. **Double Corliss Dash Pot that cushions in opening and closing. As they are sealed and out of current steam flow, dirt and grit cannot bind or stick valves.**
9. **Cannot pound, spin, stick or chatter.**
10. **By disconnecting pilot valve, the triple-acting style can be changed into plain non-return.**

GOLDEN-ANDERSON

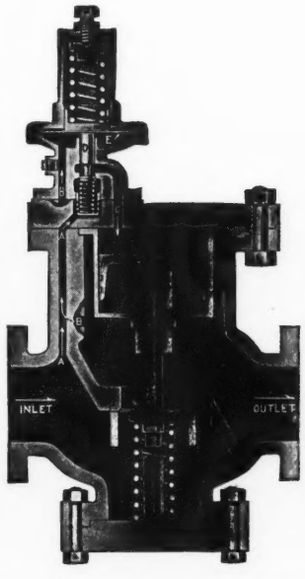
1314 Fulton Bldg.

To Modern Power Plant Operation

For thirty-two years this company has been designing and building specialty valves — not as a "side line", not as a "supplementary line" — but as an *exclusive* line. Result, Golden-Anderson today is one of America's largest contributors of specially engineered valves for *specific* steam and water service. Four leaders of this line are shown here. The catalog illustrates the line complete. Ask for a copy.

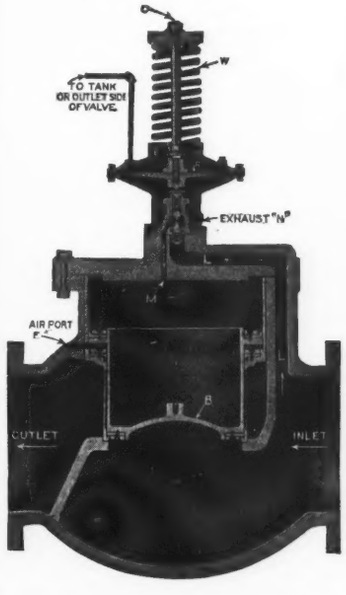
GOLDEN-ANDERSON
Steam Pressure Reducing Valve

Two types—G-A Reducing Valve, in three styles, which maintain constant low pressure from a high pressure supply—G-A Relief Valves, two styles which maintain uniform high pressure to pass into low pressure system. Positive in action—reliable—durable.



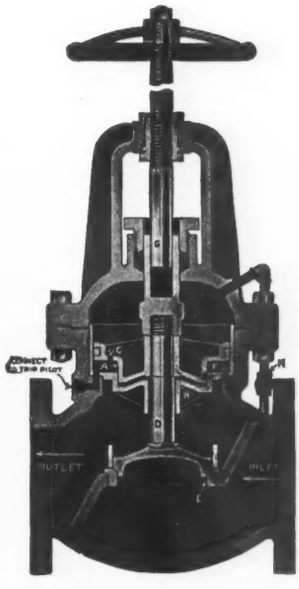
GOLDEN-ANDERSON
Altitude Control Valve

Automatic, air and water cushioned. These valves will hold water in elevated storage at exact predetermined level. No floats, long connections or complicated fixtures needed. Operation is by static head. Places control in accessible position, and is unfailing at operation.



GOLDEN-ANDERSON
Throttle and Engine Stop

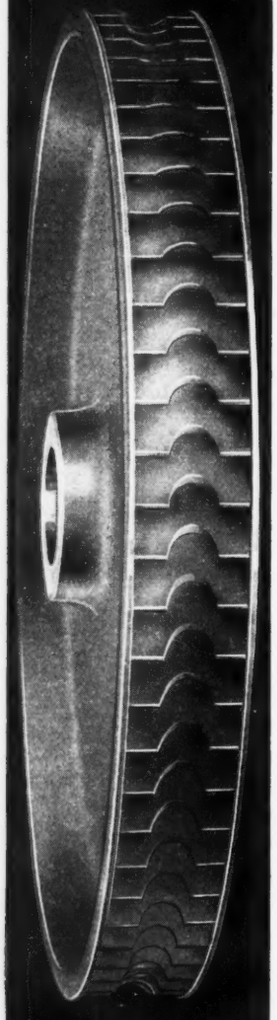
Instantly and automatically shuts off steam when engine or turbine overspeeds. Prevents flywheel explosion and wrecked turbines. May be used as a throttle valve without interfering with safety feature, as it will close on tripping from any position.

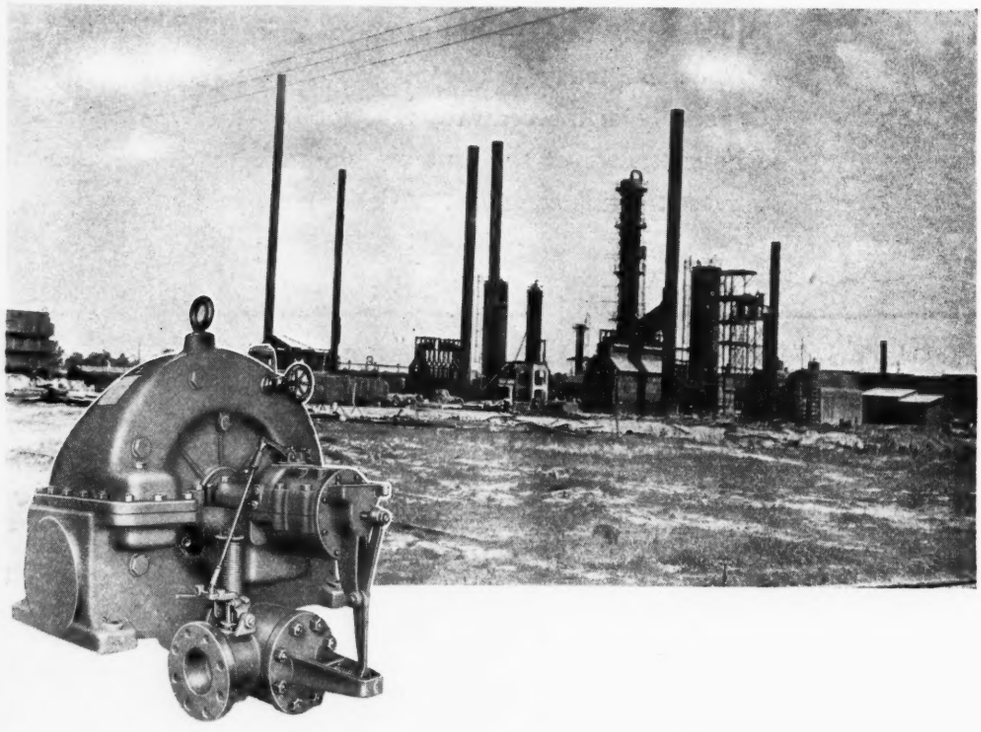


VALVE SPECIALTY CO.

Pittsburgh, Pa.

TERRY





TALCO ASPHALT & REFINING CO. SELECTS TERRY WHEEL TURBINES

For its new cracking unit at Mt. Pleasant, Texas, the Talco Asphalt & Refining Co. selected efficient Terry turbines.

There are five units and each one is equipped with the Terry solid wheel. The blades and the rotor are in one piece, so that there are no parts to become loose or work out.

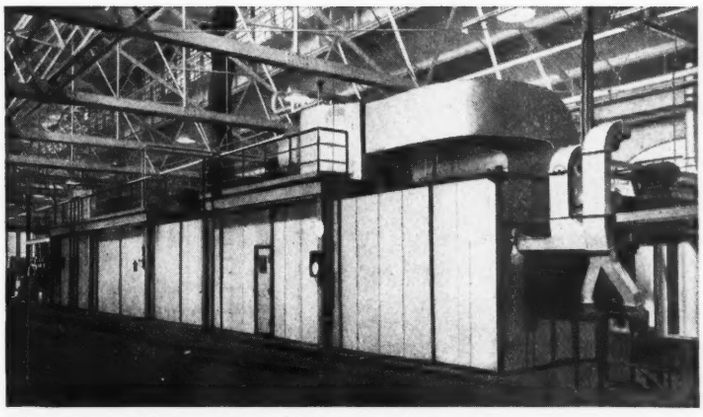
The blades have large radial clearance and are further protected by projecting rims at the sides of the wheel, which would take without damage any rubbing that might occur if this clearance became reduced. The axial clearance is very large (one inch or more), so that end play can do no harm.

The Terry Wheel Turbine is fully described in our bulletin S-116. A request on your business letterhead will bring a copy.

T-1124

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

NEW Machine Makes G-E Cable



This new machine produces 44,000 yards of 36-inch varnish-impregnated cloth in a 5-day week. That is about 1,500,000 yards of 1-inch tape.

The cloth goes through three complete coating and baking cycles. For each, it passes through the oven 16 times.

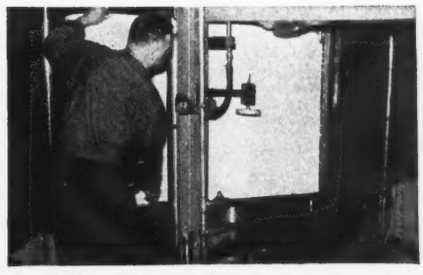
Inside, the temperature and humidity of the air remain constant—regardless of the atmosphere. The varnish is continuously circulated in a closed system; it is kept clean by straining, and the specific gravity and viscosity are always the same. Result: a uniform product.

MORE Uniform, Stable, and Long-lived

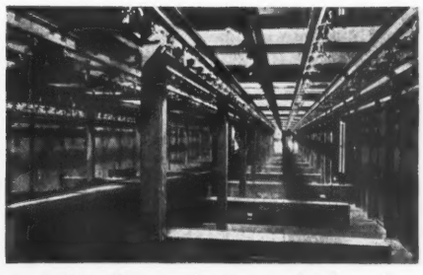
This new machine (at the left) varnish-impregnates cloth for use on G-E insulated cable. It speeds up production; but, at the same time, it controls so accurately the impregnating process that the cloth is uniform throughout its length. Result: cable insulated with this cloth has excellent electrical characteristics and will retain them for years.

In the manufacture, G. E. controls every step of the process—from the raw cloth, the special varnishes, to the finished cable. Some of these steps are illustrated.

1. This raw cloth is made to G-E specifications; and containing little sizing, it readily absorbs the varnish.



2. Cloth starts on its long journey through the 90-foot oven. Here the first coating of varnish goes on.

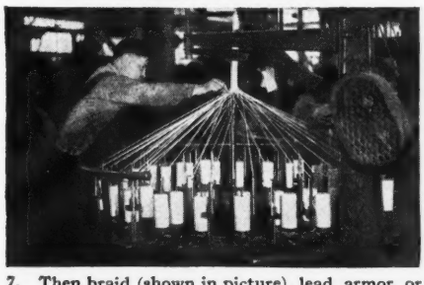


3. Inside of oven, showing overhead track on which cloth runs. Air blown down dries the cloth uniformly.

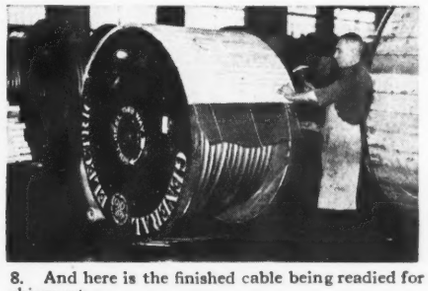
4. Cloth is taken off here and put through the oven twice more. That's to make sure the cloth is thoroughly impregnated with varnish.

5. Next the cloth is sliced into strips varying in width from 3/16 inch to 2 1/2 inches.

6. Then it is applied on conductor: two layers; then flushed with compound; then two more layers. And so on.



7. Then braid (shown in picture), lead, armor, or other protective finish is put on.



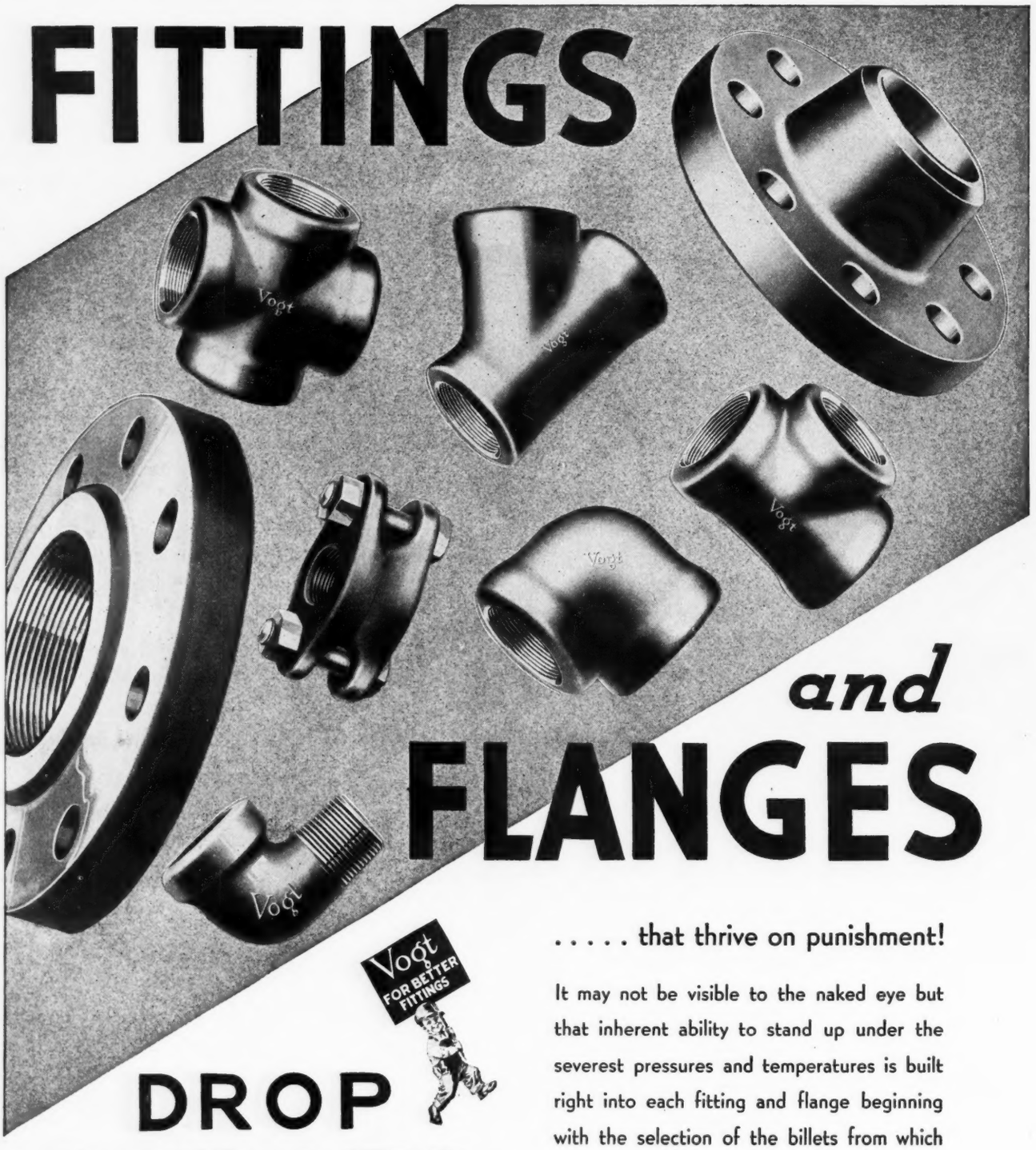
8. And here is the finished cable being readied for shipment.

THESE shots are, of course, just the highlights of an interesting story. More details are given in Bulletin GEA-2623, which contains complete information on all types of cloth-insulated cable. For a copy address the nearest G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y.

520-119

GENERAL ELECTRIC

FITTINGS and FLANGES



DROP FORGED by Vogt

. . . . . that thrive on punishment!

It may not be visible to the naked eye but that inherent ability to stand up under the severest pressures and temperatures is built right into each fitting and flange beginning with the selection of the billets from which they are forged.

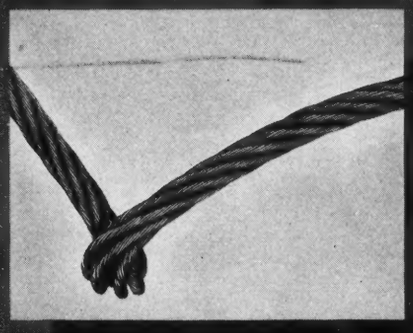
It has taken us twenty-five years to learn how. You can buy them in a minute or less.

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE KENTUCKY

Manufacturers of: Drop Forged Steel Valves and Fittings, Ice Making and Refrigerating Machinery, Oil Refinery Equipment, Water Tube Boilers, Heat Exchangers.

NEW YORK PHILADELPHIA CLEVELAND CHICAGO CINCINNATI KANSAS CITY DALLAS

IN PREFORMED ROPE



If loops are pulled, inseparable kinks are formed in a Wire Rope.

INSTALLATION IS LESS COSTLY

Select the Rope that Fits Your Job

Wisscolay Preformed Wire Rope is inherently limp. It has no tendency to form into loops while being threaded through equipment. The time-consuming care required to avoid looping of non-preformed rope is not necessary when handling preformed rope. Threading is done with a minimum of stoppage and delays and the entire installation is quicker and less expensive. Savings in installation costs and economies of use many times offset the slightly higher purchase price of Wisscolay Rope. Write today for full particulars.

•

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WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

WIRE ROPE by Wickwire Spencer

Wickwire Spencer also manufactures all sizes and types of Wire Rope in Wisscolay.

WICKWIRE SPENCER STEEL COMPANY
41 East 42nd St., New York City

Please send me my free copy of your popular, new money saving manual, "Know Your Ropes".

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INSIST ON mono-therm INDICATING THERMOMETERS!

Summed up it means just this: Foxboro mono-therm Dial-Type Thermometers give you the most for your money . . . and you can *always* read them. The Foxboro Company, 68 Neponset Avenue, Foxboro, Massachusetts, U. S. A. Branch Offices in 25 Principal Cities.

they give you:

mono-therm system—The finest thermal unit construction.

Accuracy—Precision over the entire scale range. Each instrument individually calibrated.

Maximum Visibility—From a distance of 20 feet and at a wide angle the 12-inch long scale is easily read.

Flexibility of Location—The indicator may be located as much as 200 feet away from the bulb. A number of instruments may be grouped where convenient.

Longer life—Less wear...no leakage...and least danger of breakage.

Individual Certification—Your guarantee of satisfactory instruments and dependable performance.

FOXBORO
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Certified **INDICATING THERMOMETERS**

TIGHT JOINTS

with

LINEAR

GASKETS

With Gaskets from LINEAR Sheet Packings every joint will be a permanently TIGHT JOINT.

Use Gaskets from LINEAR Sheet—Compressed Asbestos, Rubber, Duck Inserted, Cloth Inserted, Fibre or Synthetic Compounds and make a TIGHT JOINT that will stay tight.

There's a LINEAR Sheet for every Gasketing service.

Linear Packing & Rubber Co., Inc. Tacony, Phila., Pa.

The Super Chief is AAF PROTECTED

ANOTHER outstanding endorsement of American Air Filters for railway service is found in their exclusive use on the Santa Fe's new Super Chief.

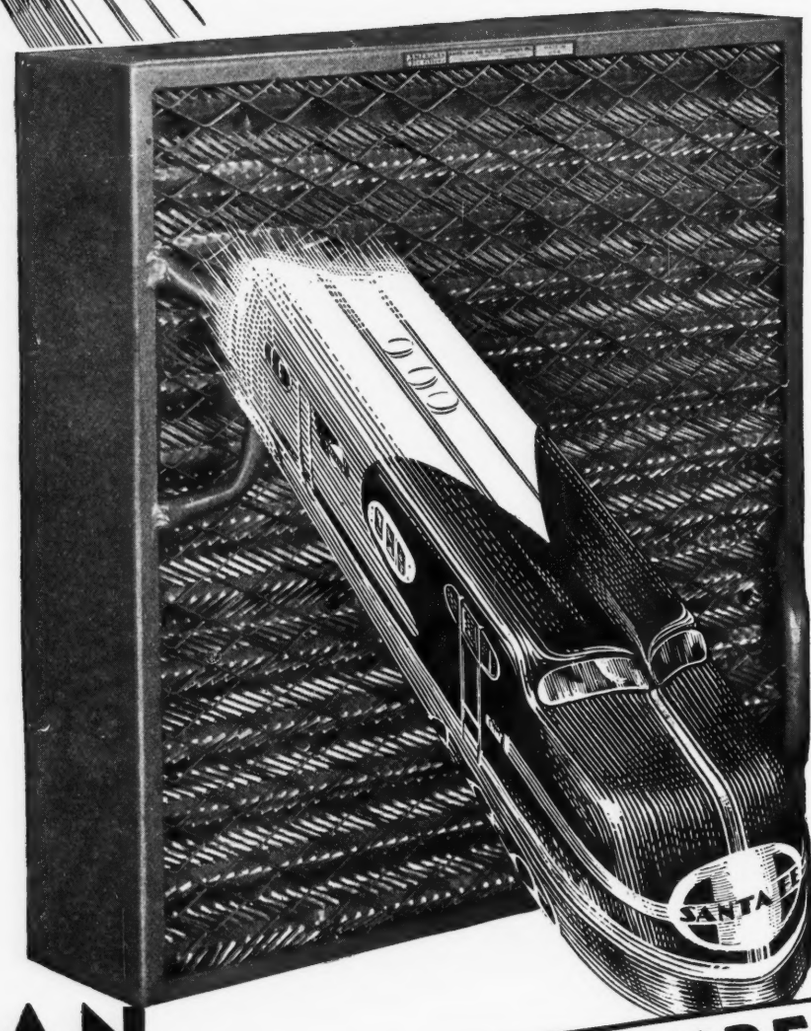
All of the conditioned air for the Super Chief's nine cars first passes through American Air Filters to eliminate the dust, dirt and grit, thus helping to maintain the reputation which modern rail travel has won as the cleanest, most comfortable and safest mode of transportation.

Here is further confirmation that American M/W 4 filters are "standard" for railroad service. More than 7000 railroad cars as well as practically all of the stream line trains in service today are equipped with these filters.

Write for complete information on the AAF M/W Type Permanent filters.

AMERICAN AIR FILTER CO., Inc.
403 Central Ave., Louisville, Ky.

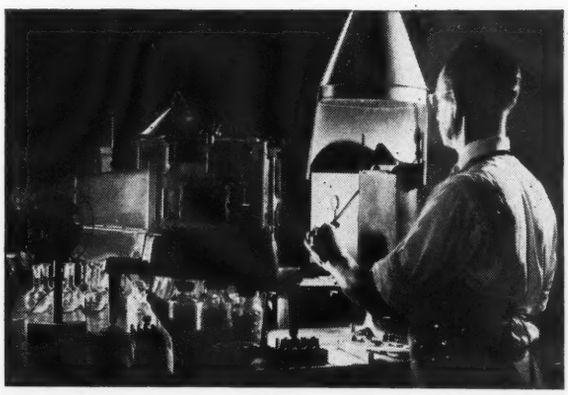
In Canada:
Darling Bros., Ltd., Montreal, P. Q.



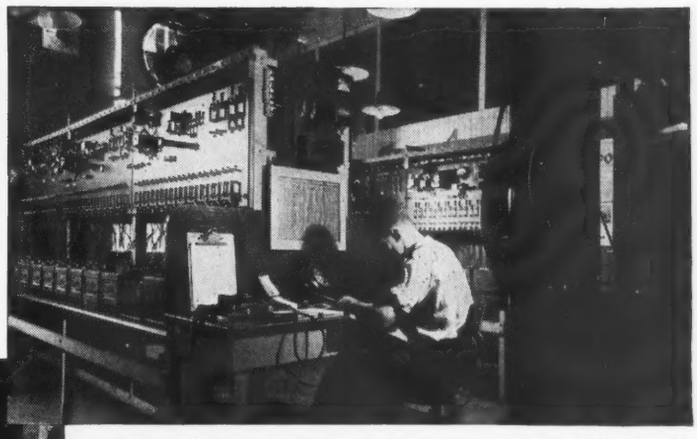
AMERICAN PERMANENT RAILROAD TYPE AIR FILTERS

Exide outlaws guesswork in building batteries

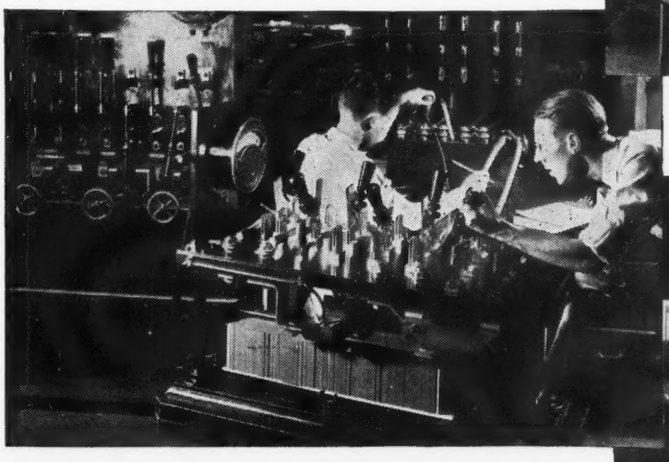
. . . these grueling tests produce a battery you can depend on for Diesel engine starting . . .



To guard against the slightest impurity, the materials for Exide Batteries are tested by means of the spectroscope—the most efficient tool man has devised for identifying minute traces of such substances.



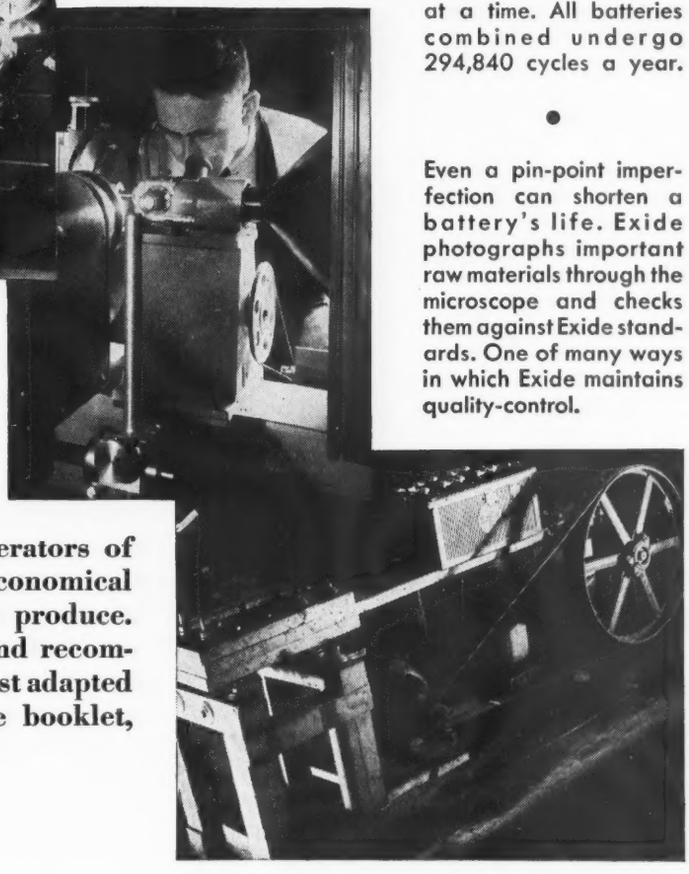
Exide's "life cycle" test compresses a year of the hardest service into a single month. Charge, discharge, then charge again . . . dozens of test batteries at a time. All batteries combined undergo 294,840 cycles a year.



After chilling a battery to 0°F., Exide makes it deliver more than enough power to crank a Diesel engine at frigid temperatures. The test determines how long the battery will keep on delivering power at this tremendous rate.

•

Even a pin-point imperfection can shorten a battery's life. Exide photographs important raw materials through the microscope and checks them against Exide standards. One of many ways in which Exide maintains quality-control.



222 bumps per minute on a special "bumping machine," hour after hour for three days. Each battery tested receives 999,000 smashing blows—a combined force that would hurl a giant locomotive many feet in the air.

REPRESENTATIVE Exide Batteries must come through these tests with flying colors. That is why they assure operators of Diesel engines the most dependable and economical electric cranking service it is possible to produce. Exide engineers are equipped to make sound recommendations on the type and size of battery best adapted to your requirements. Write for new, free booklet, "Electric Starting of Diesels," Form 3960.

Exide
BATTERIES
FOR STARTING DIESEL ENGINES

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

POWELL STEEL VALVES

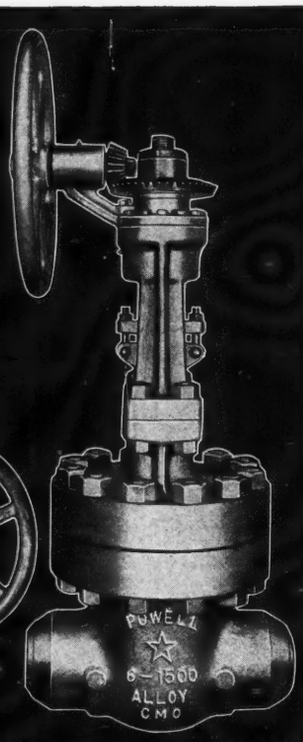


FIG. 1303 — CAST ALLOY STEEL GATE VALVE, GEAR OPERATED.

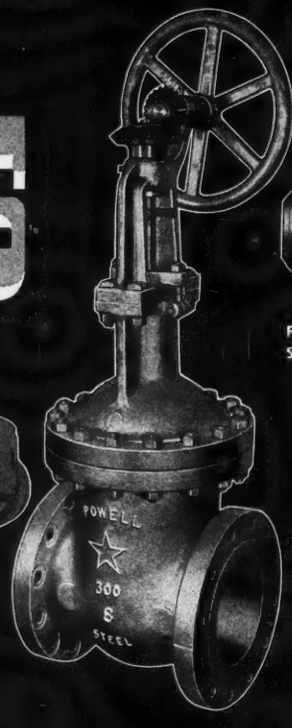


FIG. 3003—CAST STEEL GATE VALVE, GEAR OPERATED.

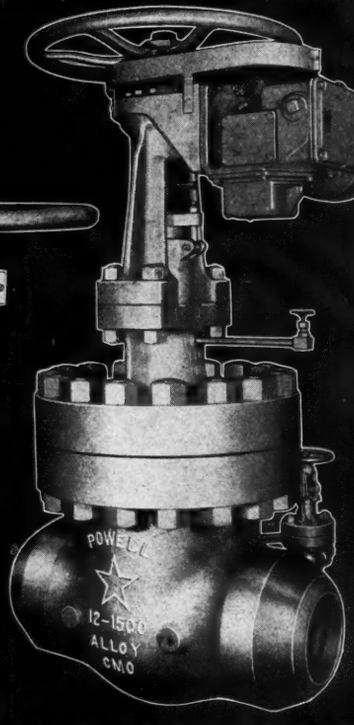


FIG. 1323 — CAST ALLOY STEEL GATE VALVE, WITH BY-PASS — MOTOR OPERATED.

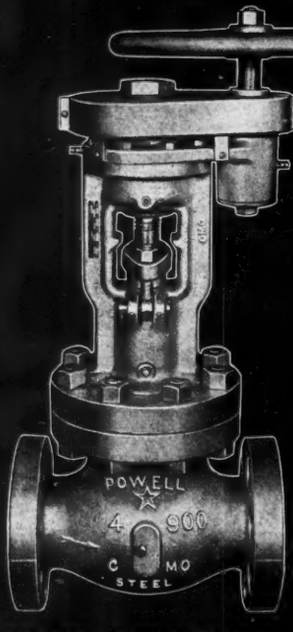


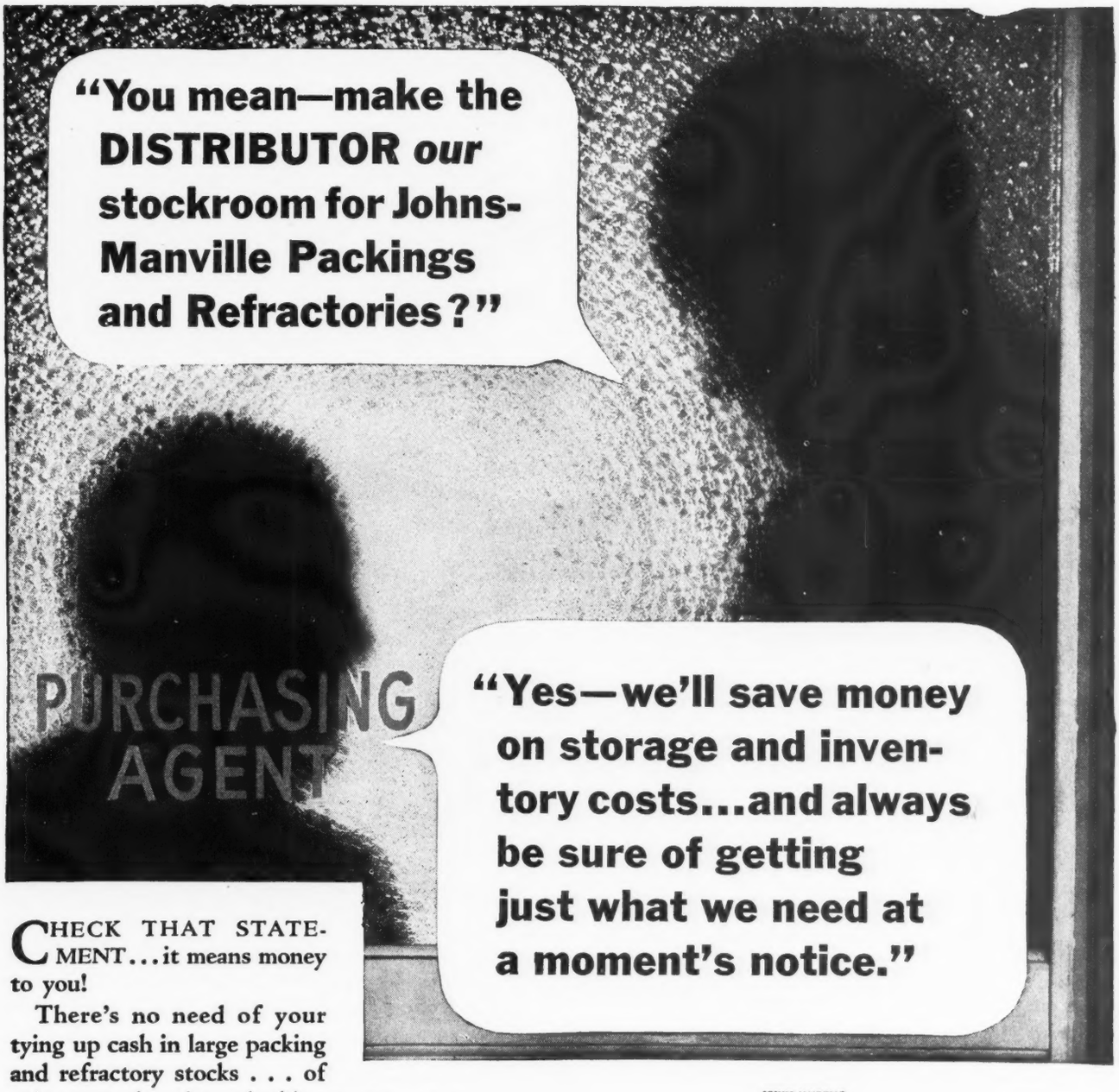
FIG. 9031—CAST ALLOY STEEL GLOBE VALVE, GEAR OPERATED

Many years of Steel Valve manufacturing has made Powell the accepted leader in this field. Uniform construction and laboratory tested metal reduces your upkeep to a minimum.

Replace now with Powell Steel Valves—detailed information will be supplied on your request.

POWELL VALVES

THE WM. POWELL CO. CINCINNATI, OHIO


"You mean—make the DISTRIBUTOR *our* stockroom for Johns-Manville Packings and Refractories?"
PURCHASING AGENT
"Yes—we'll save money on storage and inventory costs...and always be sure of getting just what we need at a moment's notice."

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There's no need of your tying up cash in large packing and refractory stocks . . . of using up otherwise valuable storage space. And even when you do, the particular packing or refractory needed is often "among the missing" . . .

But consider this: A highly rated distributor, carrying J-M Packings and Refractories, can serve you *promptly* from a more complete stock than you could possibly want or profitably afford to carry.

And remember this, too. You can be sure of satisfaction with every J-M product you buy through J-M Distributors. Over 50 years spent in developing packings and refractories, and in servicing every industrial need, are behind these Johns-Manville products today. Their dependability, durability and economy are a matter of record.

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the answer TO ANY WELDING REQUIREMENT IS A PAGE SHIELDED ARC ELECTRODE

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PAGE Shielded Arc Electrodes . . . Hi-Tensile "C", Hi-Tensile, and Page Allegheny stainless steel . . . are giving excellent results.

The same results are available to you. Whether your requirements call for high tensile strength, great ductility, deep penetration, high speed deposit, overhead welding—there is a Page Electrode that will meet your needs for production efficiency and welding excellence.

Because good wires particularly suited to the job are so essential to sound welding it is good business to standardize on Page . . . the complete line of electrodes . . . each electrode shop-tested.

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AMERICAN CHAIN & CABLE COMPANY, Inc.
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ANDREW C. CAMPBELL DIVISION
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FORD CHAIN BLOCK DIVISION
Chain Hoists • Trolleys

HAZARD WIRE ROPE DIVISION
Green Strand Wire Rope • "Korodless" Wire Rope • Preformed Spring-Lay Wire Rope • Guard Rail Cable

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Owen Cushion and Mattress Spring Centers

PAGE STEEL AND WIRE DIVISION
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READING-PRATT & CADY DIVISION
Valves • Electric Steel Fittings

READING STEEL CASTING DIVISION
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WRIGHT MANUFACTURING DIVISION
Chain Hoists • Electric Hoists and Cranes

ACCO

PAGE *Welding* WIRE

COME to EXPERTS

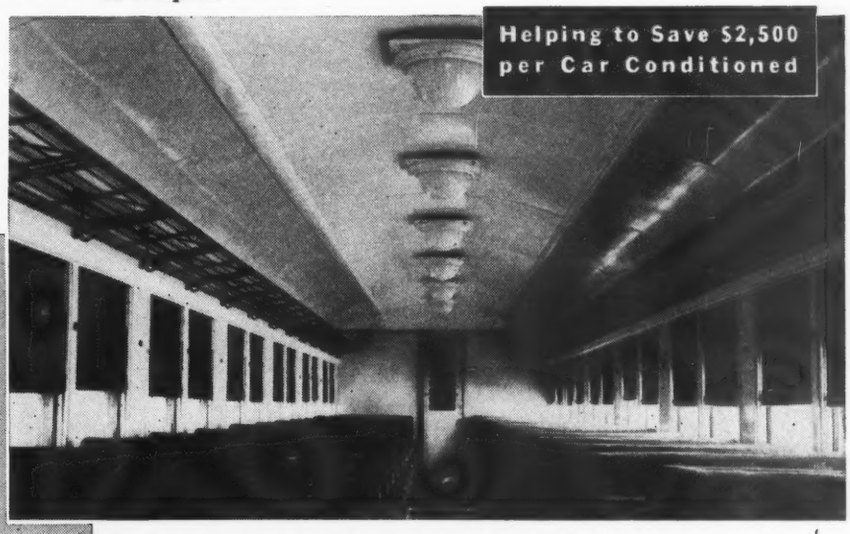
Every industry has developed leadership. Air handling and air conditioning is no exception.

When you have any type of "air" problem — in your factory, office, power plant, store, theatre or hotel — remember the name CLARAGE. This name ranks high in the air handling and conditioning field.

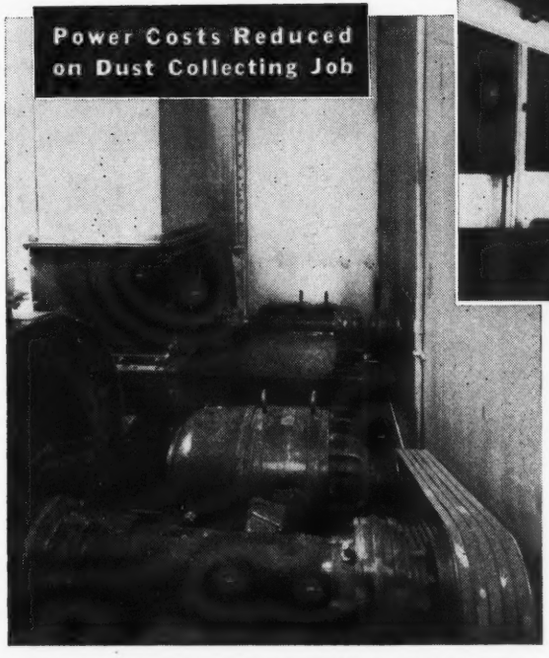
We manufacture fans, blowers, mechanical draft apparatus, unit heaters, coolers and conditioning equipment for every need — products seasoned by over a quarter-century of experience.

Your requirements entrusted to us are in EXPERT hands — and that always means RESULTS with UTMOST ECONOMY.

14,500 FEET OF WELDING ON 36 FANS—One certain process in a large chemical plant demands conditioned air almost microscopically clean. Clarage furnished the fans for this exacting job — 36 of them built of Monel metal to prevent corrosion. Photo above shows Clarage skilled workers completing one of the fan housings. Our 25 years' experience counts for a great deal when you have unusual service conditions to conquer.



RAILROAD USES CLARAGE FANS—The average cost of air conditioning a passenger coach is approximately $4000. Yet one mid-western railroad has reduced this cost to $1500 per coach conditioned — and results not sacrificed. Clarage Fan Units of special design play an important part in this economy program. Yes, savings of substantial proportion are often effected by adopting the recommendations of Clarage engineers.



NEW HIGH-SPEED, HIGH-EFFICIENCY DESIGN—Even on the simplest exhaust fan application, it pays to consult Clarage. The use of our new Type W Fan can make possible as high as a 25% reduction in size of motor required for drive — and invariably operating costs (power consumption) are below normal expectations.

Nation-Wide Service

Why not give us a chance to present facts and figures? In every major industrial center, there is a Clarage sales-engineering office, manned by air handling and conditioning EXPERTS. Use your local telephone, or write us. We will carry through from then on—and promptly. No obligation, of course.

COMPLETE AIR CONDITIONING
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COOLING
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FACTORY HEATING
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FANS and BLOWERS for INDUSTRIAL NEEDS

CLARAGE FAN COMPANY—KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

FOR A QUICK GET AWAY

. . . From High Cost Power

Use Superior Diesels

Use Superior Diesels—one of the soundest self-liquidating investments for the average power user.

Apply them with common sense and good engineering principles and watch your power cost DROP to 1c per KWH or less.

Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R.P.M.

HIGH SPEED MODELS: 15 to 150 H.P., 900 to 1800 R.P.M.

THE NATIONAL SUPPLY COMPANY — SUPERIOR ENGINE DIVISION

FACTORIES: Springfield, Ohio; Philadelphia, Pa. · SALES OFFICES: Springfield, Ohio; Philadelphia, Pa.; New York, N. Y.; Los Angeles, Calif; Houston, Texas.

THE WORLD'S
fastest complete
BOILER TUBE
SERVICE
BOILER
TUBE COMPANY
OF AMERICA
Centrally located warehouses, large stocks of nationally known makes of tubes manufactured to A. S. M. E. specifications, accurately bent and templet tested assure you the kind of tubes you want—when you want them. Write us for quotations. Boiler Tube Company of America, 3126 Preble Avenue, Pittsburgh, Penna.
PITTSBURGH * NEW YORK * PHILADELPHIA * CHICAGO *

GOULDS PUMPS CUT COSTS

Because Goulds Pumps operate at a low maintenance cost, give longer life and cost less in the beginning, practically every industry uses Goulds Pumps to obtain dependable service and lower pumping cost. These highly efficient pumping units are saving many productive pumping hours—many dollars, by providing twenty-four hour pumping service—free from shut-downs for repairs.

Goulds Centrifugal Pumps, Piston Pumps, Rotary Pumps and special pumps are available to meet individual requirements. Sizes suitable for pumping water and other industrial liquids at any rates and pressures.

Obtain all the details about how Goulds Pumps cut pumping costs, write directly to us.

GOULDS PUMPS Inc.

SENECA FALLS N. Y.

ATLANTA, BOSTON, CHICAGO, HOUSTON, NEW YORK, PHILADELPHIA, PITTSBURGH, TULSA, Representatives in all Principal Cities

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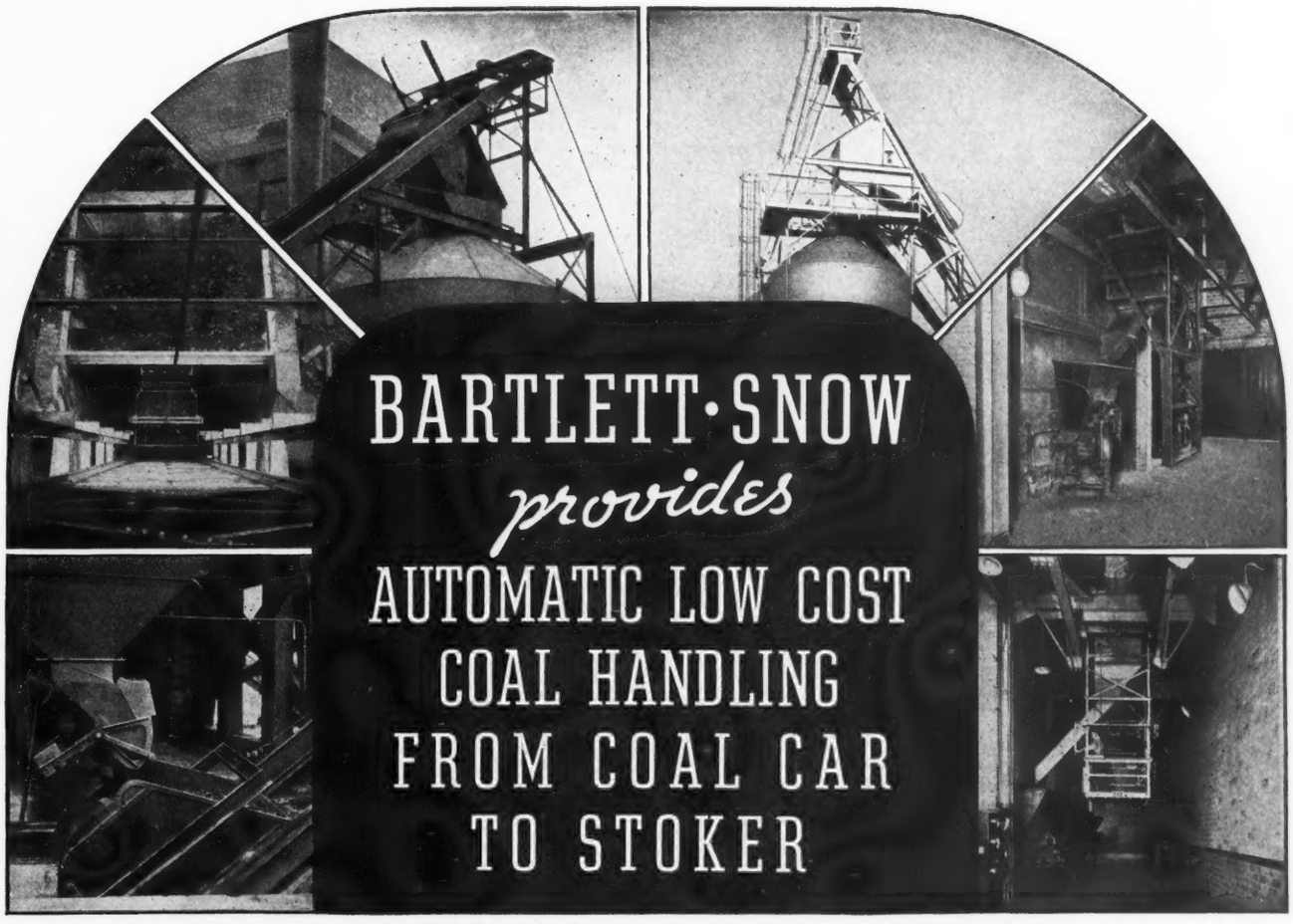
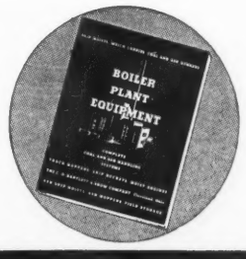


BARTLETT·SNOW *provides* AUTOMATIC LOW COST COAL HANDLING FROM COAL CAR TO STOKER

● From the time it leaves the coal car until it is deposited in the stoker hopper, a Bartlett-Snow system handles the coal in a continuous, automatic and efficient manner.

Track hoppers are of generous size with sloping sides to eliminate arching. Loading gates are of automatic, and patented design. They close by gravity when the bucket is filled. Scraping and banging are avoided. Hoist engines, skip buckets, runways, head frames and bunkers are of proven Bartlett-Snow construction. The weigh larries eliminate segregation . . . prolong stoker and furnace life.

Six standard boiler plant layouts bring the advantages of this proven system within the reach of every engineer and boiler plant official. They reflect in their arrangement 35 years of intimate customer experience . . . combine maximum dependability with low operating and low maintenance costs. Each is adapted for installation in existing or new buildings . . . can be altered to meet a variety of plant and yard conditions. The layouts require a minimum of new engineering . . . permit therefore the maximum amount of the appropriation to be expended for actual plant facilities. Full details will be found in Bulletin 73. Send for a copy.



THE C. O. BARTLETT & SNOW CO.
6205 Harvard Avenue **Cleveland, Ohio**

In New York—30 Church Street
In Chicago—First National Bank Building

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BULLETIN NO. 73
Complete with 44 diagrams, 12 tables, 90 illustrations. Describes the Bartlett-Snow method of securing less costly—more efficient operation. Send for one.

BARTLETT·SNOW
Coal and Ash Handling Equipment

TRACK HOPPERS • LOADING GATES • SKIP HOISTS • HOIST ENGINES
BUNKERS • WEIGH LARRIES • ASH HOPPERS • FIELD STORAGE

LOWER YOUR INVENTORY INVESTMENT
with Walworth A. A. R. Valves
BIG STRONG ... RELIABLE
WALWORTH
REORDERING MADE EASY...
ELIMINATE
VALVE TROUBLE ON PIPE LINES
For the "DIFFICULT" Liquids...
Compliments of the Season and may 1938 bring you Health, Happiness and Prosperity . . .
STILLSON
GATE VALVES
FAREWELL TO LEAKY VALVES!
IN THESE NEW BRONZE VALVES
YOUR PIPING!
Run it easier... quicker... and leak-proof...with Walseal
WALWORTH
WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK
VALVES FITTINGS and TOOLS
Backed by 85 Years' Service
DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

STOWE STOKERS

give high efficiency on 4 • 10 • 12 and even 20% ash Coals

IT'S THE END OF RESTRICTED HIGH PRICE COAL BUYING!

● New, modern, and characterized by impartial observers as the greatest forward step in mechanical firing in the last ten years, Stowe Stokers enable operators to buy the coal that represents lowest cost per B. T. U. laid down in their storage yard—with entire confidence—regardless of its analysis or burning characteristics.

Stowe Stokers of similar construction are burning, at high efficiency, the entire range of fuels from 5% ash Pocahontas slack to the high ash low fusing coals found west of the Mississippi River. They permit operators to change from one coal to another as strikes, fires, fluctuating mine prices, and changing rail, water and truck rates make one coal or another the more advantageous to burn.

A simpler, less costly operation results. Stowe Stokers permit the use of a less costly furnace construction. They reduce the carbon loss in the ash. They minimize draft problems and stratification of gases, and provide other efficiencies and economies so great that one user reports: "The savings I have effected with Stowe Stokers are so great I could not afford to use other types even if they were given to me free."

More complete details and a fully illustrated and descriptive catalog will be sent on request. Send for a copy. It will pay you to investigate Stowe Stokers' many exclusive features—and the savings they can make—for either new or modernization projects in your plant!

GET A STOWE STOKER PROPOSITION . . . A LETTER WILL BRING IT ●

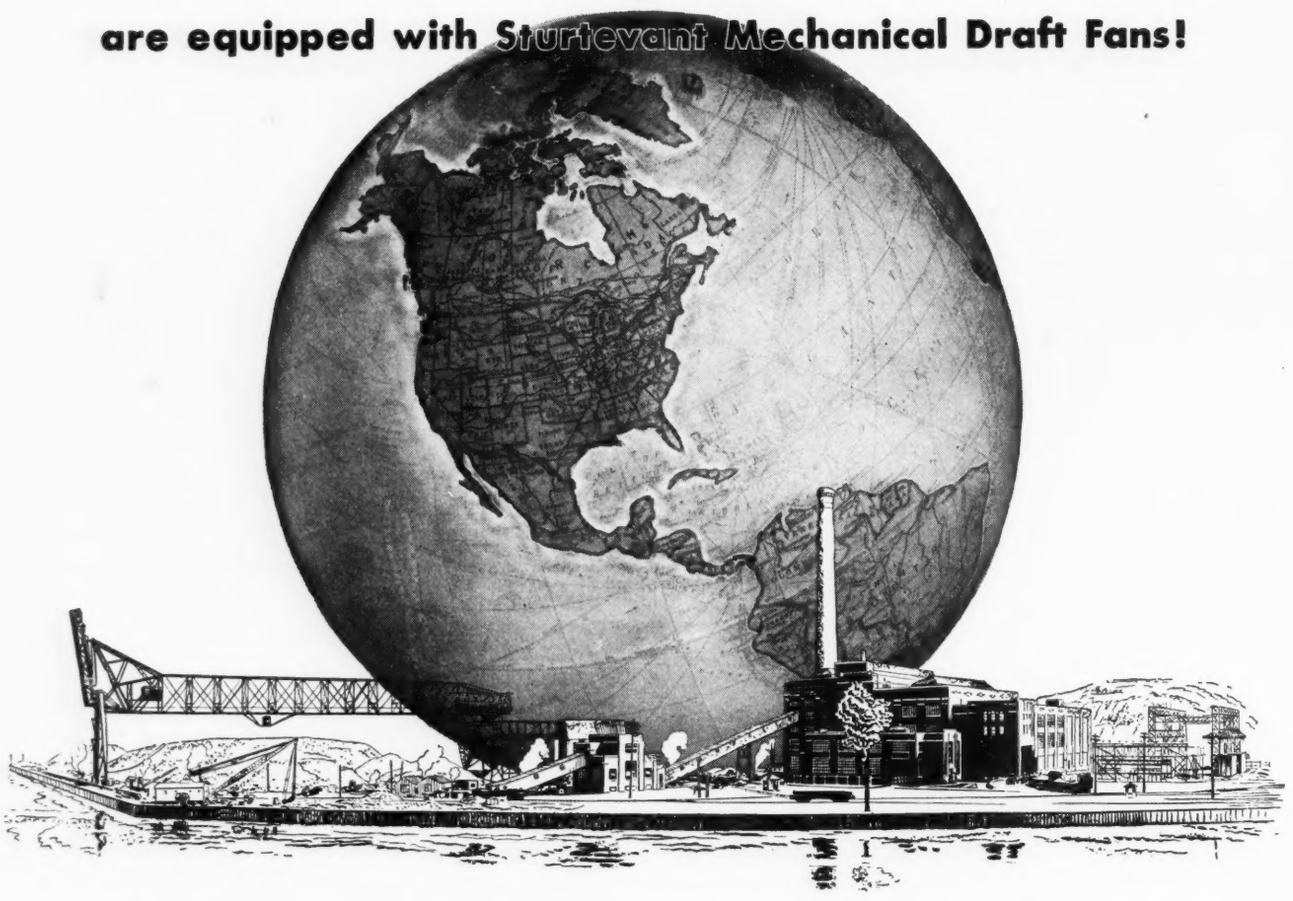
THE JOHNSTON & JENNINGS CO., 878 Addison Road, Cleveland, Ohio

STOWE STOKERS

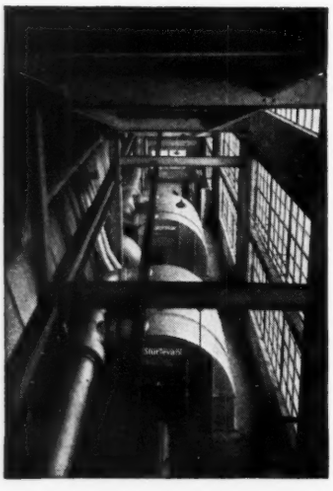
Compensating Feed

World's Outstanding POWER STATIONS

are equipped with Sturtevant Mechanical Draft Fans!



PORT WASHINGTON STATION—MILWAUKEE ELECTRIC RAILWAY & LIGHT CO.
—ONE OF THE LEADING PLANTS OF THE UNITED STATES



At Port Washington Station:—

(1) Sturtevant Draft Fans handle almost 2½ million pounds of gas per hour.

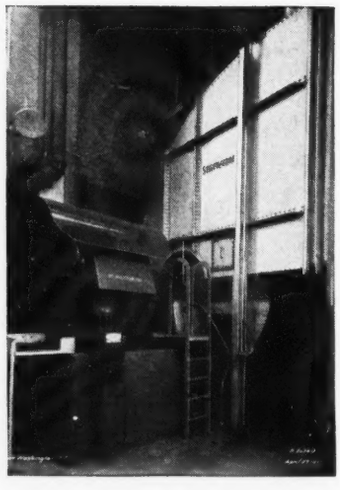
(2) Forced Draft Fans operate at peripheral speed of 3 miles per minute, and are conservatively understressed even at this high speed.

(3) Induced Draft Fans handle flue gas at a temperature of 370 Dgs. F., against static discharge pressure of 11.5 inches water gauge. Designed to reduce erosive wear to a minimum.

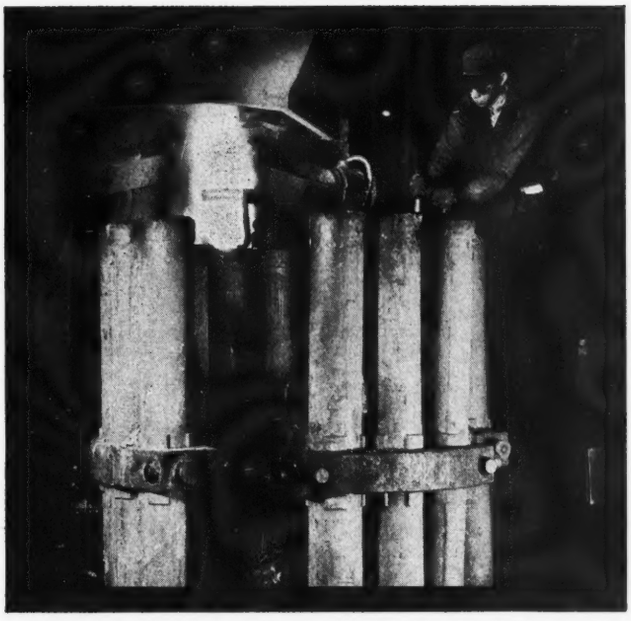
B. F. STURTEVANT CO., Hyde Park, Boston, Mass.
Branch Offices in 40 Other Cities
B. F. Sturtevant Company of Canada, Limited—Galt, Toronto, Montreal

Sturtevant
REG. U. S. PAT. OFF.

Puts Air to Work



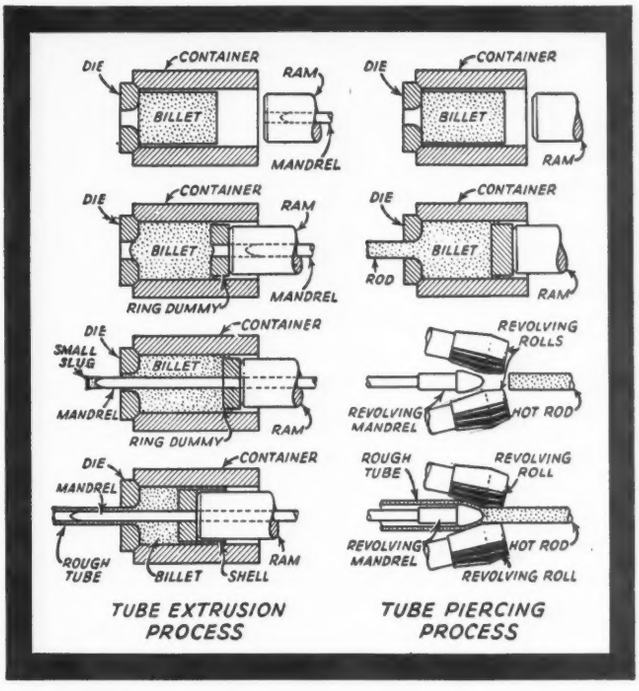
DRAFT FANS · TURBINES · GEARS · ECONOMIZERS · AIR HEATERS



IN CONDENSER TUBE MANUFACTURE

the process employed is determined by the physical characteristics and working properties of the particular alloy. For example, Admiralty metal, ductile when cold, weak and brittle when hot, is made by the Cast Shell Process—casting a heavy walled tube; then cold drawn down to finished size. The first draw is particularly severe as the metal has not yet been worked and refined by annealing and will split and reject any but perfectly sound castings. All Bridgeport casting operations are today carried out in electric melting furnaces under skillful supervision and close pyrometric control. Photograph at left shows operator pouring the molten alloy into the casting shell.

Other alloys which are best hot worked are made by the extrusion process. Two methods of making extruded tubes, diagramed at right, are widely used today. (a) In the Tube Extrusion Process, a solid cast billet is first upset, then pierced by a mandrel, which spreads the metal so that it backfills and only a small slug is forced through the die (by no means does it remove the entire core) and finally extruded in tube form. (b) In the Tube Piercing Process, a similar cast billet is heated red hot and first extruded in the form of a solid rod. Then the rod is reheated and put through a second hot working operation where it is forced between tapered rolls and simultaneously pierced with a revolving mandrel to form a heavy tube. In the Piercing Process two severe compressions at high temperatures under enormous pressures assure thorough forging and refining of the metal structure.



After the tube is formed it is drawn, annealed and redrawn many times until the final tube size is reached. Photo shows an annealing furnace where tubes are annealed under precisely regulated conditions. No method of testing or inspection will permit anyone to take a mixed batch of condenser tubes and identify the method of manufacture.

However, the most important factor influencing tube life remains in the selection of the right alloy to meet conditions of a specific individual installation. Bridgeport condenser and heat exchanger tubes are made in all the standard alloys listed here. A Bridgeport Condenser Engineer will be glad to cooperate with you in analyzing your problem and help you determine the alloy best adapted to resist the corrosive conditions that are found. Consult with Bridgeport on your next job.

BRIDGEPORT BRASS

"Bridgeport" BRASS CO.

BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN. • ESTABLISHED 1865

BRIDGEPORT
CONDENSER AND HEAT EXCHANGER TUBES

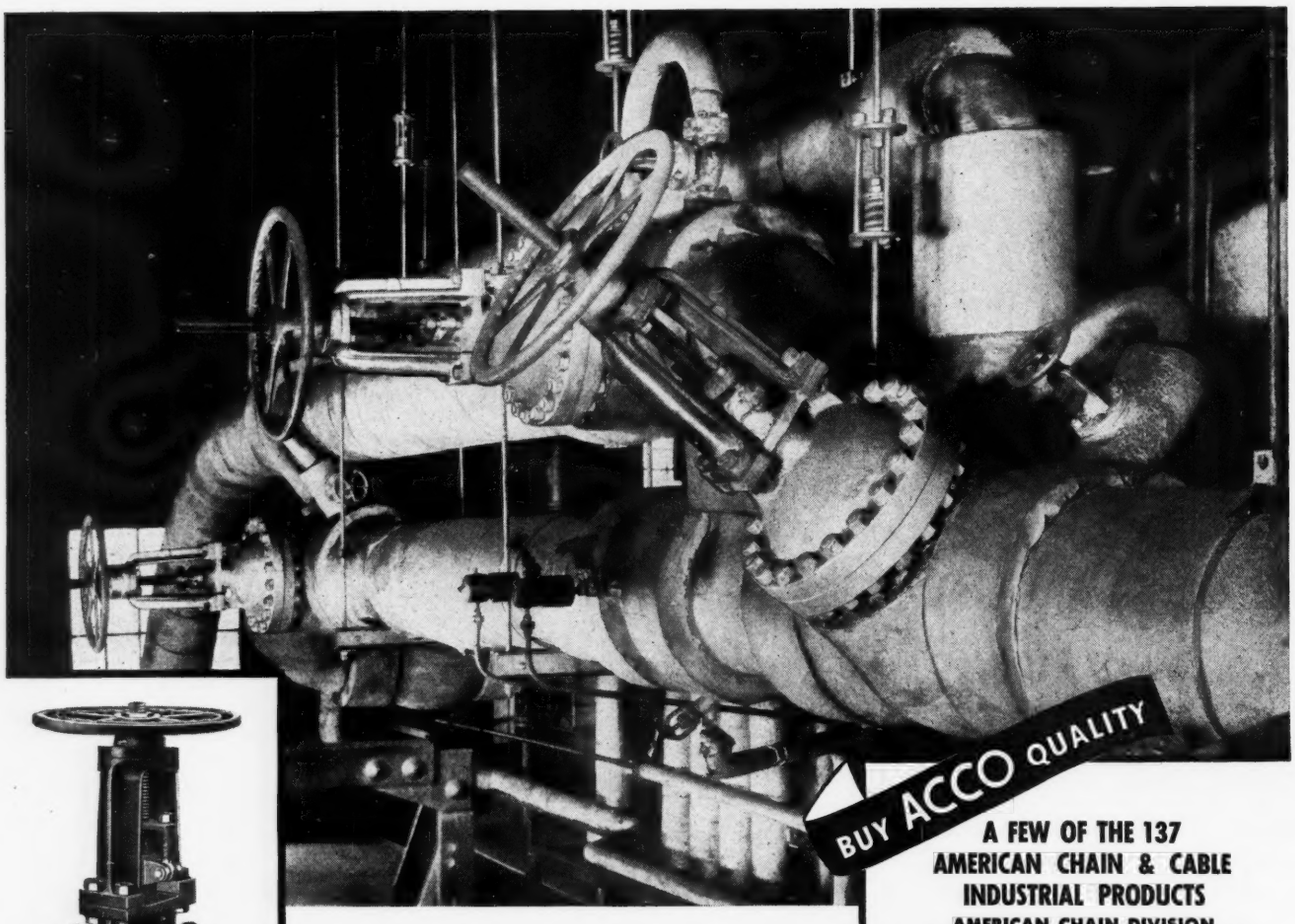
Admiralty	Cupro Nickel 70-30
Cuzinal (Aluminum Brass)	Cupro Nickel 80-20
Duronze II	Muntz
Duronze IV	Copper (Deoxidized)
Tin Red Brass	Copper (Arsenical)
Red Brass	Aluminum Bronze

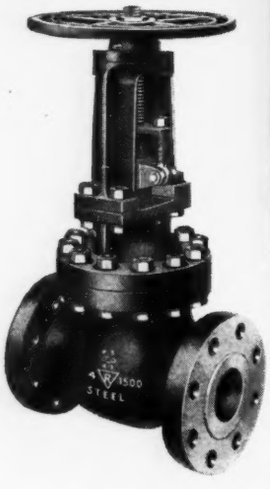
EVAPORATOR AND SUGAR TUBES

Copper (Deoxidized)	Copper (Arsenical)

CONDENSER PLATES

Circles	Rectangles
Squares	Segments





FOR HIGH PRESSURES HIGH TEMPERATURES..

● Here is pictured an installation of Reading Steel Valves of several years ago—at the top ranges of temperature and pressure of its day. The single valve at lower left is today's valve corresponding to those in the installation.

Today a variety of alloys for main castings and metals for trims are offered according to the service—steam station, refinery or others. Now, as in the past, the materials and design of Reading Steel Valves are such as to give unfailing performance in the services for which they are recommended.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT, CONNECTICUT

In Business for Your Safety

A FEW OF THE 137 AMERICAN CHAIN & CABLE INDUSTRIAL PRODUCTS

AMERICAN CHAIN DIVISION
(DOMINION CHAIN COMPANY, Ltd., in Canada)
Weed Tire Chains • Welded and Weldless Chain • Malleable Castings • Railroad Specialties

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Wrought Iron Bars and Shapes

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Owen Cushion and Mattress Spring Centers

PAGE STEEL AND WIRE DIVISION
Page Fence • Wire and Rod Products Traffic Tape • Welding Wire

READING-PRATT & CADY DIVISION
Valves • Electric Steel Fittings

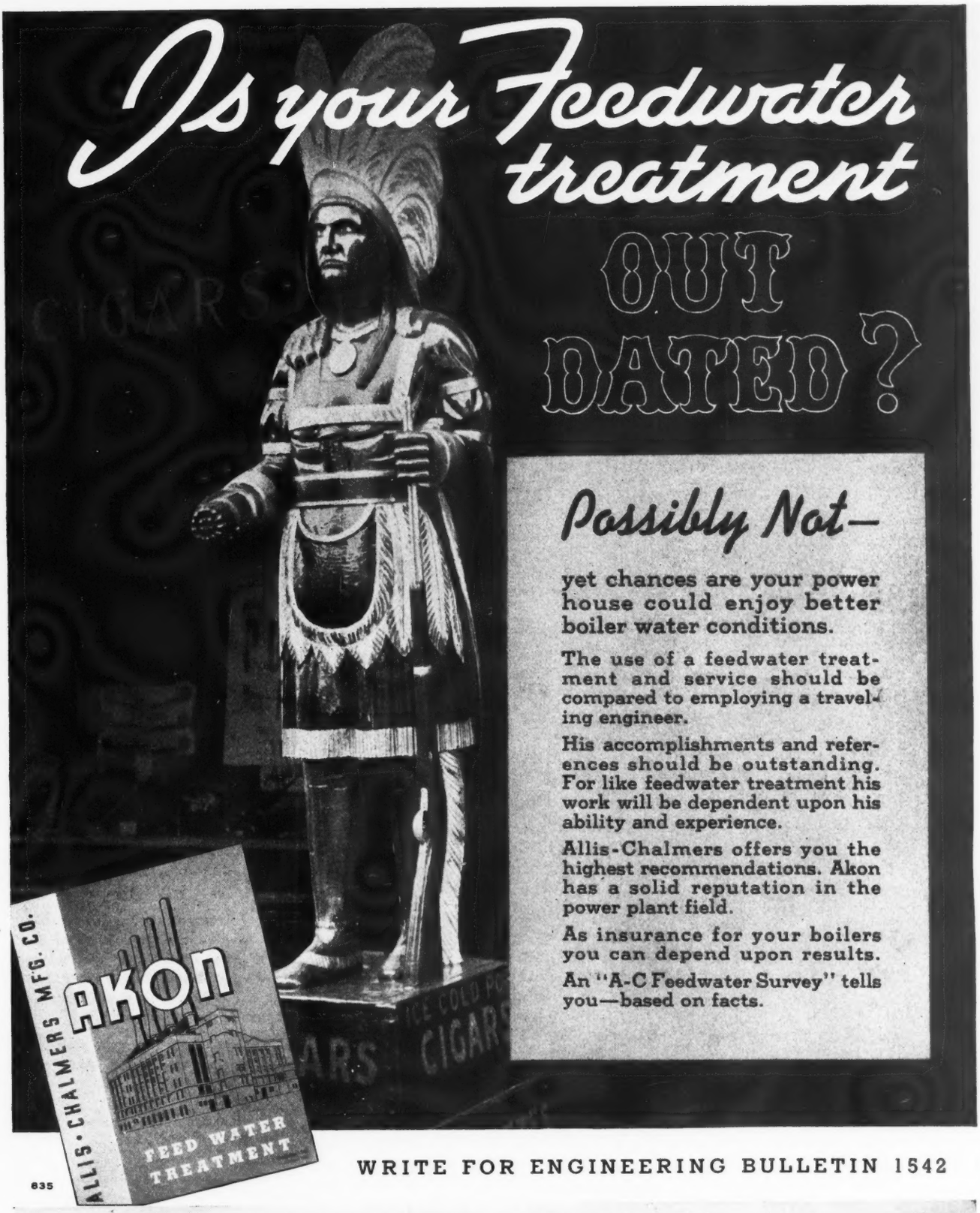
READING STEEL CASTING DIVISION
Electric Steel Castings, Rough or Machined

WRIGHT MANUFACTURING DIVISION
Chain Hoists • Electric Hoists and Cranes

READING•PRATT & CADY VALVES

ACCO QUALITY VALVES • MADE IN A PLANT DEVOTED EXCLUSIVELY TO MANUFACTURING VALVES

Is your Feedwater treatment OUT DATED?



Possibly Not—

yet chances are your power house could enjoy better boiler water conditions.

The use of a feedwater treatment and service should be compared to employing a traveling engineer.

His accomplishments and references should be outstanding. For like feedwater treatment his work will be dependent upon his ability and experience.

Allis-Chalmers offers you the highest recommendations. Akon has a solid reputation in the power plant field.

As insurance for your boilers you can depend upon results.

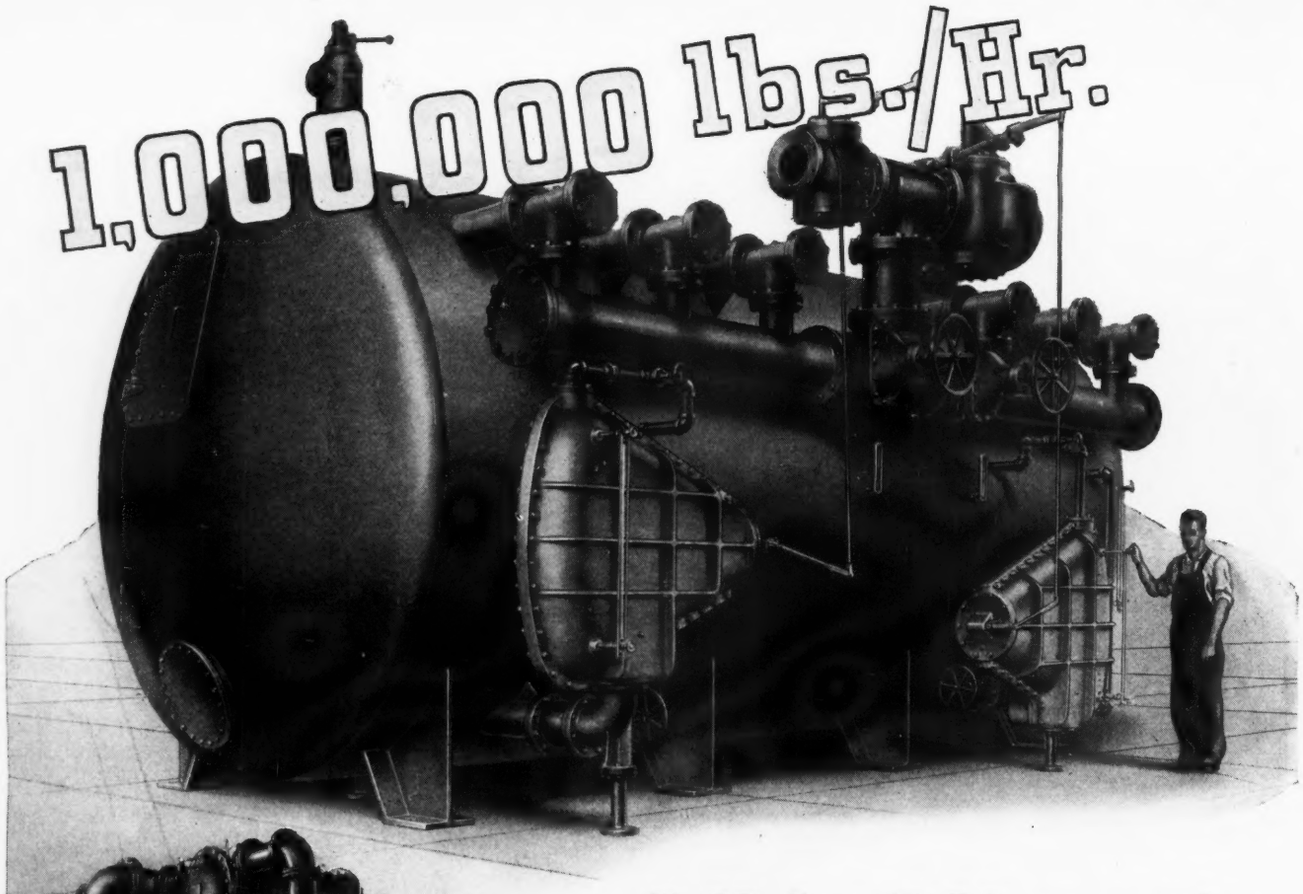
An "A-C Feedwater Survey" tells you—based on facts.

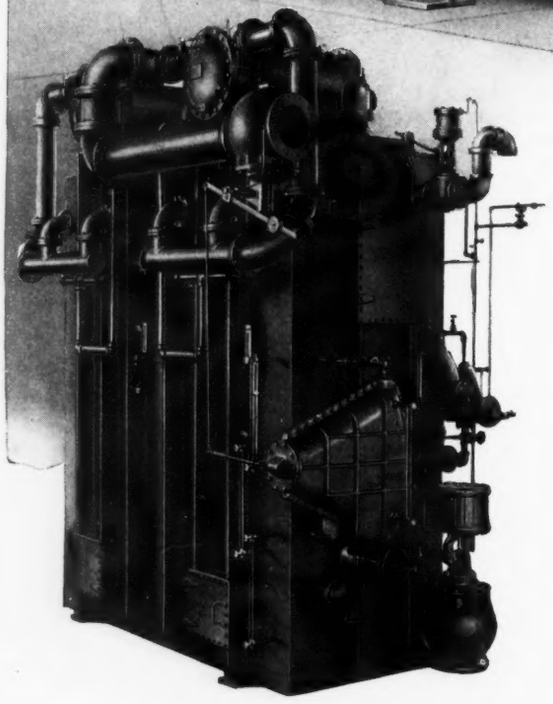
WRITE FOR ENGINEERING BULLETIN 1542

EQUIPMENT ENGINEERS TO INDUSTRY

ALLIS-CHALMERS

MILWAUKEE WISCONSIN





A Major Achievement in Deaerating Equipment

Cochrane Deaerators for unusually large capacities have met with widespread acceptance by a steadily increasing number of users in all classes of industry during the past year. While the guarantee of a million pounds per hour of water of zero oxygen content is a noteworthy accomplishment, Cochrane is equally proud of the sustained performance records of its many smaller deaerating units—of 100,000 Lbs./Hr., and less.

Every major development in the field of deaeration in the last decade may be attributed mainly to the knowledge and experience of the Cochrane organization in solving the new feed water conditioning problems arising from the trend toward increased generating capacities; keeping pace with the rapid changes and steady growth of deaeration in the power, chemical and process industries.

This evidence of continued leadership is assurance that your problems in eliminating oxygen corrosion by complete deaeration of your feed water can be solved by calling on Cochrane.

Write for recent bulletins on latest designs in deaerating heaters and hot process water softeners.

COCHRANE CORPORATION • 3106 North 17th St. • Philadelphia, Pa.

COCHRANE

WATER SOFTENERS • DEAERATING HEATERS • DEAERATORS • BLOW-OFF EQUIPMENT • VALVES • FLOW METERS

"50,000 More Kilowatts Right Away? OK!"

● The engineer in the control room knows he can build up the load surely and quickly with the help of his battery of "Buffalo" Limit-Load Forced Draft Fans.

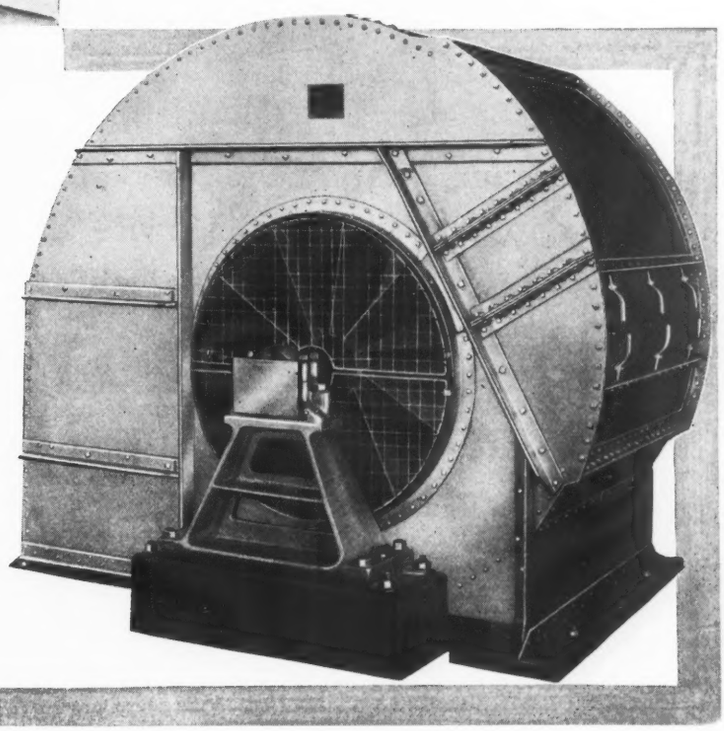
When these giant fans start to roll, steam pressure rises by the second, and generators send out the increased supply "on time."

Whether you are interested in modernization or new plants, it will pay you to get the facts on "Buffalo" Forced Draft Fans.

BUFFALO FORGE COMPANY
488 Broadway **Buffalo, N. Y.**
Branch Engineering Offices in Principal Cities
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

SUPER LIMIT-LOAD FORCED DRAFT FANS



Based On
Service and Long Life
YOUNGSTOWN'S
Forged Steel Unions
Are The
Lowest In Cost

2000 POUND UNIONS PRICED IN LINE WITH 300 POUND UNIONS

Youngstown believes that industry needs quality Unions and builds them accordingly.....Youngstown's Unions are forged from solid, round, steel bars - our specification No. 451...The two straight matched cone seats are machined and cold rolled under one to ten tons pressure.....This means eight times longer life.....The nut threads on Youngstown's Unions are permanently lubricated with udylite cadmium.....They will not gall or freeze..... Ask your jobber for Youngstown's Unions and learn of the real savings that a quality union can give you.

PETRO
Steel to Steel Seats

HYDRO
Brass to Brass Seats

MARK
Brass to Steel Seats

THE YOUNGSTOWN SHEET AND TUBE COMPANY
Manufacturers of Carbon and Alloy Steels
General Offices - YOUNGSTOWN, OHIO
Unions - Tin Plate - Sheets - Plates - Pipe and Tubular Products - Conduit - Bars - Rods - Wire - Nails - Tie Plates and Spikes

FORGED STEEL TRADE MARK YOUNGSTOWN UNIONS

24-2

YOUNGSTOWN

NEW JENKINS 'ARMOR-SEAT'

Defeats Toughest Valve Enemies

This Jenkins Valve has a PLUG SEAT made of Jenkins JX500 stainless steel EXCEEDING 500 BRINELL HARDNESS

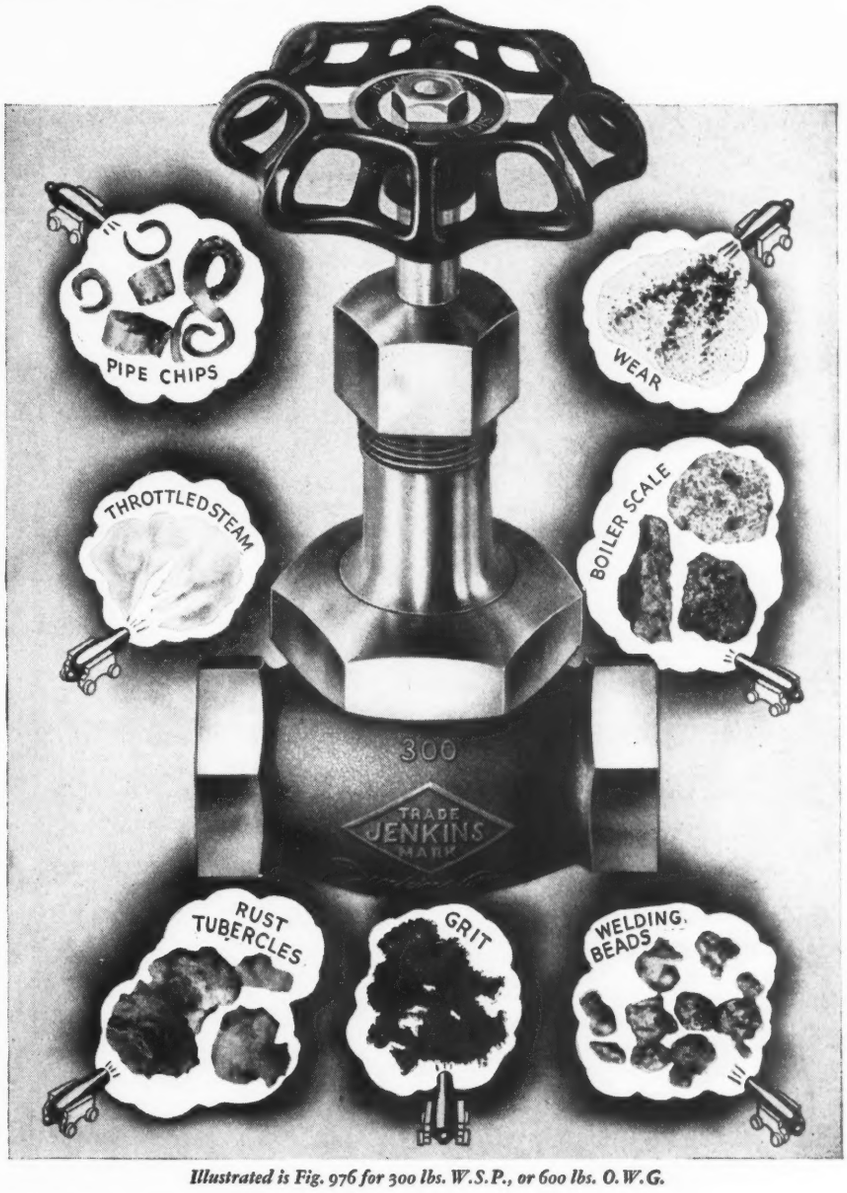
In presenting this Fig. 976 Plug-Seat Valve, Jenkins Bros. is confident that it is as near to being wear-proof, maintenance-proof and trouble-proof as a stock valve can be made. Back of it is a long period of development and testing to prepare it for the toughest services.

Natural enemies of valve seats such as boiler scale, pipe chips, grit and other substances commonly encountered in pipe lines, cannot injure the seating parts. Plug and seat ring are made of Jenkins JX500, a superior stainless steel having a Brinell hardness in excess of 500. Maximum wear-resistance is obtained and maintenance, due to seat damage, is reduced to the lowest possible degree.

Put this Jenkins to a service test on the worst place you know... continuous throttling for pressure reduction or free blow duty such as soot blowers, injectors, heating coils, or on any steam line where close regulation is required. Fig. 976 is specially recommended where such severe service is encountered. The JX500 plug and seat practically nullify wear and almost entirely eliminate danger of wire drawing and cutting.

If you have a tough valve job we ask only that you let this new Fig. 976 show what it can save you in maintenance and replacement expense. Ask your supply house for complete information, or write us.

JENKINS BROS., 80 White Street, New York; 510 Main Street, Bridgeport; 524 Atlantic Ave., Boston; 133 North Seventh Street, Philadelphia; 822 Washington Boulevard., Chicago; JENKINS BROS., Limited, Montreal, Can.; London, England

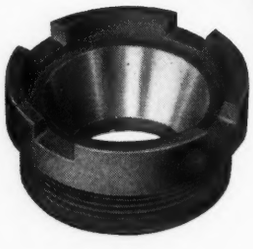


Illustrated is Fig. 976 for 300 lbs. W.S.P., or 600 lbs. O.W.G.

HOW HARD IS 500 BRINELL? Nothing that would conceivably get into the valve could scratch the Jenkins JX500 stainless steel seat. Compare 500 Brinell hardness with the hardness of some substances which do get into pipe lines... boiler scale, pipe chips, welding beads, rust tubercles, iron oxides... even with other familiar objects that are softer, such as a common nail which is under 200 Brinell hardness.

Jenkins Valves MADE FOR LIFETIME SERVICE

The *Why* of Wider Seat Faces!



"NS5" Alloy Plug Type Seat and Disc

The greater area of the full plug width seating surface combined with the fine wearing properties of "NS5" Alloy retards wire drawing and promotes longer service life.

"NS5" Alloy seating material is of uniformly great hardness and retains its hardness at high temperatures; it will not gall or seize, and is highly resistant to corrosion.

An added economy feature is the interchangeability of seats and discs, whereby users of Lunkenheimer regular "Ferrenewo" and "Renewo" Valves, can convert them into plug type by simply changing the seats and discs.

Place a few of these valves in service in your plant and let them prove themselves under actual operating conditions. Your Lunkenheimer distributor carries them in stock.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Buy QUALITY—Buy LUNKENHEIMER

102-88-42

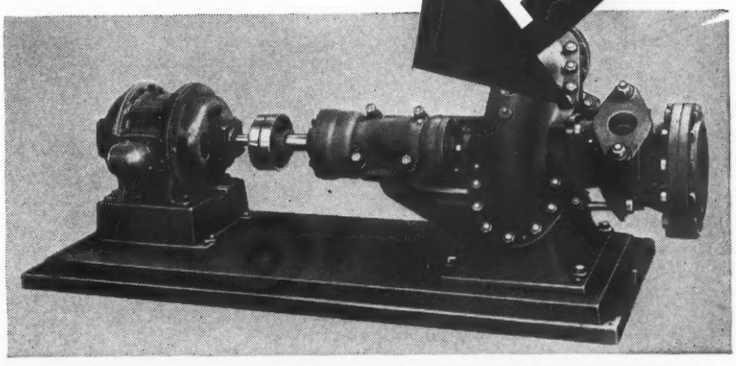
THESE show how Gould makes PUMPS

PRESSURE-TIGHT, WEAR *and* CORROSION RESISTANT

GOULDS PUMPS, INC., Seneca Falls, N. Y., makes pumps for many uses, sends them out to jobs in all parts of the world. *Some* of them have to resist corrosion; ALL of them must resist wear and be pressure-tight.

For pump castings of many intricate shapes Gould has found that Nickel makes good cast iron better. Most of the casings and impellers above are cast with mixtures containing about 1% Nickel. The more uniform grain texture eliminates cracks, increases hardness and strength. Where pumps handle corrosives, Gould uses still more Nickel, casting parts with 14% Nickel, 2% chromium, 6% copper—the alloy known as Ni-Resist.

Consultation on the use of Nickel to meet your casting requirements is invited.

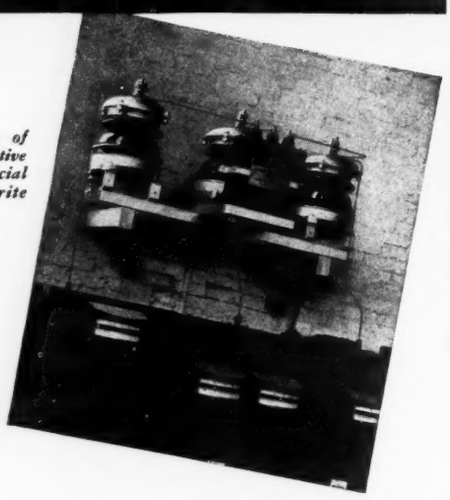


NI-RESIST★ NICKEL CAST IRON

Reg. U. S. Pat. Off. by The International Nickel Co., Inc. Canadian Patent—278,180

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

"NO FAILURE OF ANY KIND" After Installing G-E Rotating-machine Protective Equipment



Indoor installation of G-E Pyranol protective capacitor and special station-type Thyrite arrester

A LARGE industrial plant in Pennsylvania experienced numerous lightning failures of stator windings on rotating machines. G-E protective capacitors and arresters were installed in 1933. The results reported are, "no failures of any kind."

Protection to Fit the Need

Generators and other rotating machines require a *special threefold* class of lightning protection—to limit surge amplitudes, wave fronts, and reflections within the machine windings. G-E protective capacitors and arresters supply this protection, are easily installed, and require practically no maintenance. When it is considered that as much as 25 per cent of machine failures have been known to be due to lightning, and a much larger percentage from causes unknown are undoubtedly the result of initial damage from lightning stresses, adequate protection is clearly a low-cost insurance and a sound investment. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC 330-258

General Electric Company, Dept. 6J-201, Schenectady, N. Y.

Send me a copy of your descriptive bulletin on rotating-machine protection. (GEA-1743B)

Name .....

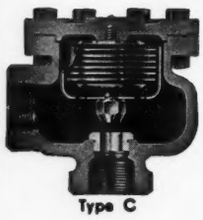
Firm .....

Address .....

City ..... *State* .....

330-258

• NICHOLSON •



Type C

A REAL TRAP

Cannot freeze (can be placed right out in the weather); is never water-logged; cannot air-bind; intermittent discharge; largest water and air discharging capacity of any trap on the market; same size valve is used on vacuum as at 200 lbs.; moderate in price. "Nicholson" Industrial Trap Bulletin No. 535 on request. Sent on trial.

NICHOLSON
Welded Steel Floats
Chromium Plated and
Stainless Steel Floats

Good for pressures up to 2,000 lbs. Round and oblong sizes 3" to 12" in stock with threaded female spud, or tube thru center. Write for Bul. No. 635. Inquiries on special floats solicited.

NICHOLSON CONTROL VALVES

TWO, THREE, FOUR-WAY AND SPECIAL TYPES

For Operating Air, Steam, Water or Oil Cylinders

Lever, Foot, Solenoid and Motor Operated Types

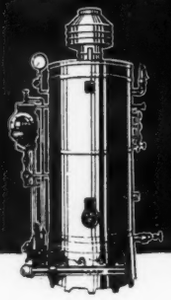
Hydraulic Pressures up to 5,000 lbs.

Other Products—Nicholson Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON and CO.

125 OREGON STREET WILKES-BARRE, PA.

A HELPFUL HINT ABOUT



TAKING INVENTORY

Go over your steam boiler equipment carefully! You may list it as an asset but, unless it's fully automatic and in first class condition, it really rates as Business Liability No. 1.

NOW IS THE TIME TO Replace Obsolete Steam Boilers!

You'll find the savings pay for a good gas-fired KANE Boiler. **Savings in *time:* the KANE is operated automatically, requires practically no manual attention; and savings in *actual cash:* the KANE burns fuel only in proportion to the steam required, isn't wasteful.**

Details? They're all yours if you write us on your letterhead. We'll send you complete construction data, certified performance reports—*and there is no obligation.*

MEARS-KANE-OFELDT INC.

Executive Offices and Factory
1903-1915 EAST HAGERT ST., PHILADELPHIA
Branch Offices or Distributors in Principal Cities

Your Reference Page for KENNEDY Valves and Pipe Fittings

Bronze Gate Valve

Bronze Globe Valve

Iron Body Gate Valve

Iron Body Globe Valve

Bronze Check Valve

Malleable Iron Elbow

Cast Iron Elbow

What KENNEDY Makes

VALVES

IRON-BODY, BRONZE-MOUNTED OR ALL-IRON

Gate Valves with Wedge or Double Discs
Globe, Angle, Check and Cross Valves
For steam pressures up to 250 lb. per sq. in.
For water, oil, air or gas pressures up to 2500 lb. per sq. in.

BRONZE

Gate, Globe, Angle and Check Valves
For steam pressures up to 250 lb. per sq. in.
For water, oil, air or gas pressures up to 400 lb. per sq. in.

Also *Underwriters' Approved Valves, Radiator Valves, Safety Swing Gate Valves,* and *Back Water and Sewer Gas Valves*

PIPE FITTINGS

MALLEABLE IRON—Black or Galvanized Screwed Fittings

BRASS OR BRONZE—Rough, Finished or Finished and Nickel Plated Screwed Fittings

CAST IRON—Standard and Extra Heavy Flanged Fittings and Companion Flanges

Where KENNEDY Products are used

ON steam, water, oil, air, and gas lines in general industrial plants, chemical and special process plants of all kinds, oil refineries and pipe lines, central power generating stations, natural and manufactured gas plants, municipal water supply and water pumping stations, fire protection systems, residences, public and commercial buildings of all types, railroads, and on shipboard.

Some Features of KENNEDY Products

METALS—Iron castings made of a mixture 50% stronger than ordinary cast iron. Bronze castings made of a specially dense, homogeneous, true bronze in fittings as well as valves. Valve stems have unusually high tensile and torsional strength.

PROPORTIONS—All parts have a large factor of safety to withstand severe service strains. Heavily reinforced pipe ends and bonnet connections, ample bolting and fully rounded corners for maximum strength.

MACHINE WORK—All machining and finishing operations are held to close limits of accuracy to assure complete interchangeabilty of all parts.

DESIGN—Each Kennedy Valve type has "extra value" features of disc, stuffing box, stem, body, bonnet and handwheel that provide easier operation, longer life and lower maintenance cost. Kennedy Fittings, too, have extra values that save time and expense on pipe fitting jobs.

THE KENNEDY VALVE MFG. CO., Elmira, N. Y.

Warehouses and Representatives in principal industrial centers

KENNEDY

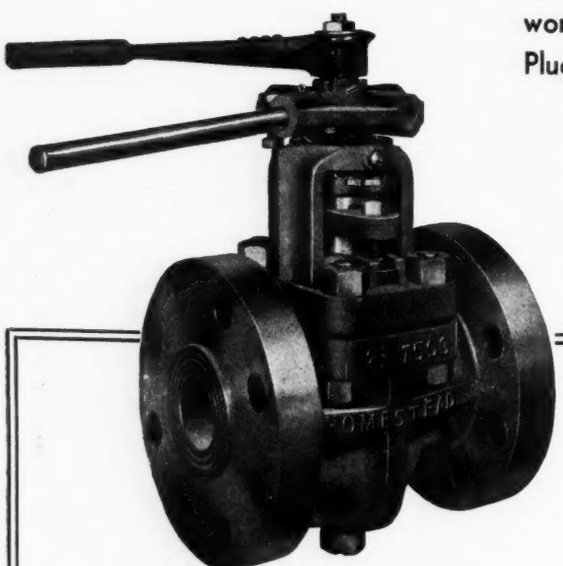
VALVES-PIPE FITTINGS-FIRE HYDRANTS

For Sure Operation Under ALL Conditions

Use

HOMESTEAD LIFT-PLUG VALVES

HOMESTEAD Lift-Plug Valves are the ANSWER to your toughest valve problems such as high temperature, pressure, or corrosive service conditions. Valve worries and maintenance end with HOMESTEAD Lift-Plug Valves on the job, and here are the reasons why:



In the power plant HOMESTEAD Lift-Plug Valves are used in combination with the Hovalco Angle Valve on boiler blow-off. Semi-steel or steel construction for pressures up to 600 pounds, or higher on order; sizes 1½", 2" and 2½".

For general plant use, HOMESTEAD Lift-Plug Valves may be had in iron, steel, bronze or special metals, sizes 1½" to 10" straight-way; and some three-way and four-way sizes available.

Get the advantages of continuous, low-cost valve performance on your more severe valve services, by specifying HOMESTEAD Lift-Plug Valves on your next valve order.

- **HOMESTEAD Lift-Plug Valves cannot stick. Powerful leverage and screw, unseal or seal valve.**
- **Controlled adjustable lift and positive stop, assures just enough rise of plug to overcome friction and permit easy operation of valve.**
- **Mechanically seated to form perfect seal. No lubrication necessary to seal or unseal valve.**
- **Seating surfaces protected in both open and closed positions.**
- **Quarter-turn to open or close. Plug turns freely to visible outside stop, after breaking seal with lift lever.**

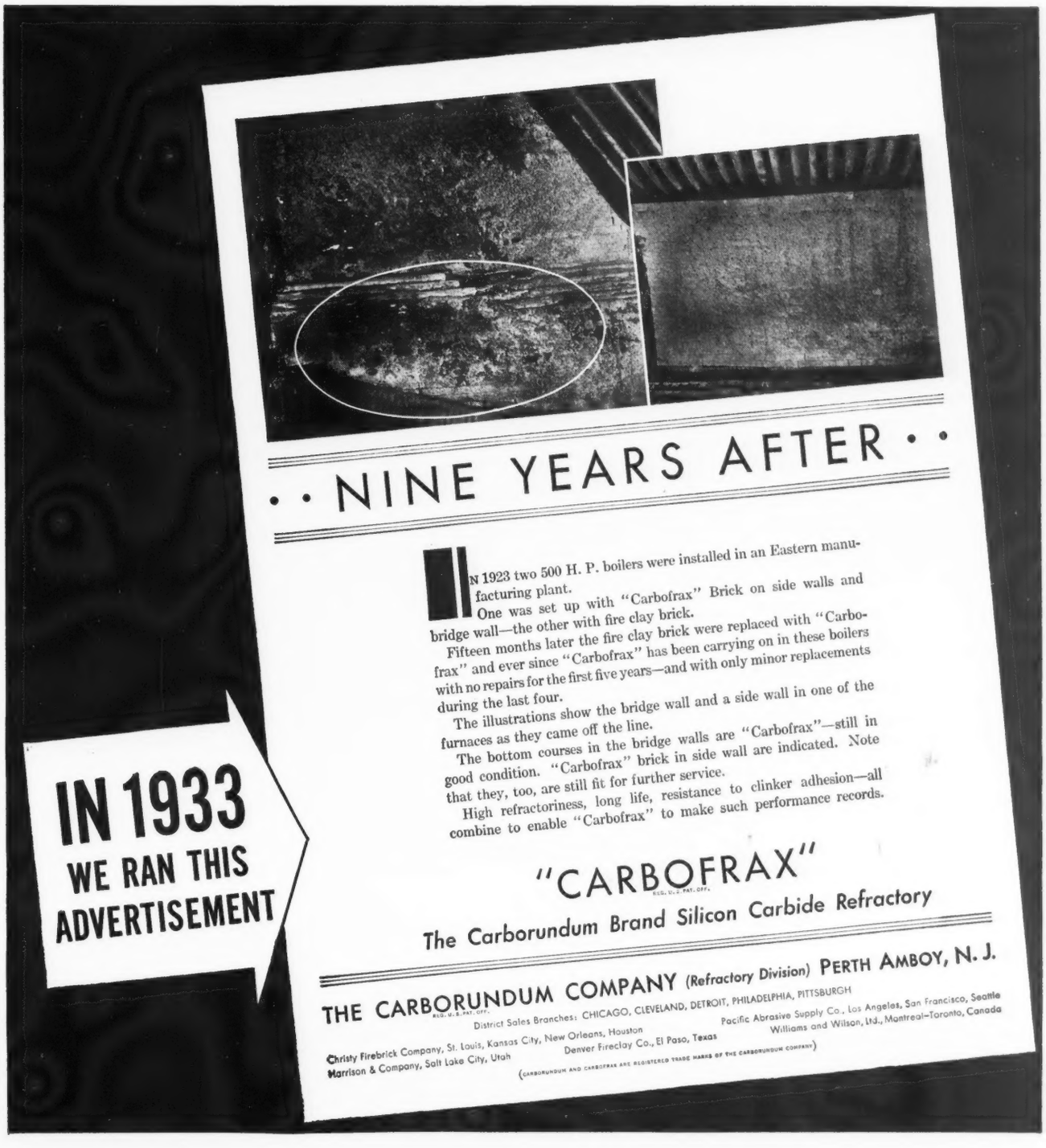
Write for complete valve reference book showing Homestead Lift-Plug Valves and other Homestead Products.

HOMESTEAD VALVE MFG. CO., P. O. Box 210, Coraopolis, Pa.

HOMESTEAD VALVES

QUARTER-TURN VALVES:
STRAIGHT-WAY
THREE-WAY
FOUR-WAY
LUBRICATED TYPE
LIFT-TYPE PLUG

PROTECTED-SEAT VALVES:
HYDRAULIC (B. & O. PAT.) OPERATING
REMOTE CONTROL
HYDRAULIC DESCALING
ROSS AIR SHUT-OFF VALVES
HOVALCO BLOW-OFF VALVES


••NINE YEARS AFTER••
IN 1923 two 500 H. P. boilers were installed in an Eastern manufacturing plant.
One was set up with "Carbofrax" Brick on side walls and bridge wall—the other with fire clay brick.
Fifteen months later the fire clay brick were replaced with "Carbofrax" and ever since "Carbofrax" has been carrying on in these boilers with no repairs for the first five years—and with only minor replacements during the last four.
The illustrations show the bridge wall and a side wall in one of the furnaces as they came off the line.
The bottom courses in the bridge walls are "Carbofrax"—still in good condition. "Carbofrax" brick in side wall are indicated. Note that they, too, are still fit for further service.
High refractoriness, long life, resistance to clinker adhesion—all combine to enable "Carbofrax" to make such performance records.
IN 1933
WE RAN THIS ADVERTISEMENT
"CARBOFRAX"
REG. U. S. PAT. OFF.
The Carborundum Brand Silicon Carbide Refractory
THE CARBORUNDUM COMPANY (Refractory Division) PERTH AMBOY, N. J.
REG. U. S. PAT. OFF.
District Sales Branches: CHICAGO, CLEVELAND, DETROIT, PHILADELPHIA, PITTSBURGH
Pacific Abrasive Supply Co., Los Angeles, San Francisco, Seattle
Williams and Wilson, Ltd., Montreal–Toronto, Canada
Christy Firebrick Company, St. Louis, Kansas City, New Orleans, Houston
Harrison & Company, Salt Lake City, Utah
Denver Fireclay Co., El Paso, Texas
(CARBORUNDUM AND CARBOFRAX ARE REGISTERED TRADE MARKS OF THE CARBORUNDUM COMPANY)

Now—5 years later... "CARBOFRAX" IS STILL GOING STRONG

REG. U. S. PAT. OFF.

9/5/14 years

Five years ago we published the advertisement shown, telling the story of the excellent service rendered by "Carbofrax" brick which had been installed nine years before in the bridge and sidewalls of these boilers.

At the end of nine years, however, these brick were "just getting their second wind". When we recently received an order from this customer for a quantity of "Carbofrax" brick, we examined their records and found that these brick were being purchased for the first major repair to these settings since 1923. Fourteen years of service at average boiler ratings of 200 per cent! Think what a saving that has meant. Is it any wonder we say "A 'Carbofrax' setting is a dependable setting"?

Let our engineers make recommendations for *your* settings.

Tune in the Carborundum Band, Saturdays at 7:30 P. M., E.S.T., Columbia Chain

REFRACTORY CARBORUNDUM PRODUCTS

THE CARBORUNDUM COMPANY, REFRACTORY DIVISION, PERTH AMBOY, N. J.
REG. U. S. PAT. OFF.

District Sales Branches: Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh. Agents: McConnell Sales and Engineering Corp., Birmingham, Ala.; Christy Fire Brick Company, St. Louis; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Co., Los Angeles, San Francisco, Seattle; Denver Fireclay Co., El Paso, Texas.

(Carborundum and Carbofrax are registered trade-marks of The Carborundum Company)

Your new TAG INSTRUMENT CATALOGS *are here!*

Wherever indications, records or the control of temperature, pressure, flow, level, time, operation or humidity are important—or Oil Testing Instruments, Etched Stem Thermometers and Hydrometers are required in the laboratory . . . the suitable instrument will be found in one of the new TAG Catalogs of which a few are illustrated here. It costs nothing to be fully informed. It will pay you to secure the catalogs of interest to you and gain the benefit of TAG's engineering service in selecting the instruments best suited to your conditions.

PYROMETERS & RESISTANCE THERMOMETERS — Catalog No. 1101-59.

INDICATING RECORDING & CONTROLLING INSTRUMENTS FOR TEMPERATURE & PRESSURE— Catalog No. 1060-59.

NON-INDICATING TEMPERATURE & PRESSURE CONTROLLERS — Catalog No. 900-59.

MAGNETIC CLUTCH FLOW INSTRUMENTS—Catalog No. 1065-59.

UNIFLOW LEVEL CONTROLLERS— Catalog No. 1137-59.

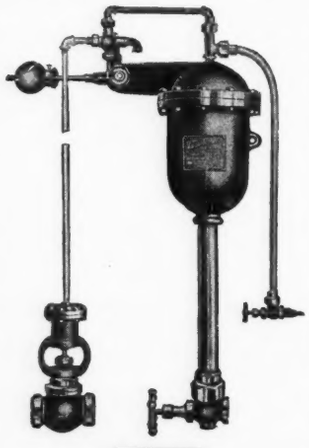
INDUSTRIAL & MISCELLANEOUS THERMOMETERS — Catalog No. 1125-59.

ETCHED STEM THERMOMETERS & HYDROMETERS—Catalog No. 1100-59.

OIL TESTING INSTRUMENTS — Catalog No. 699-59.

C. J. TAGLIABUE MFG. CO.
Park & Nostrand Ave's., Brooklyn, N. Y.

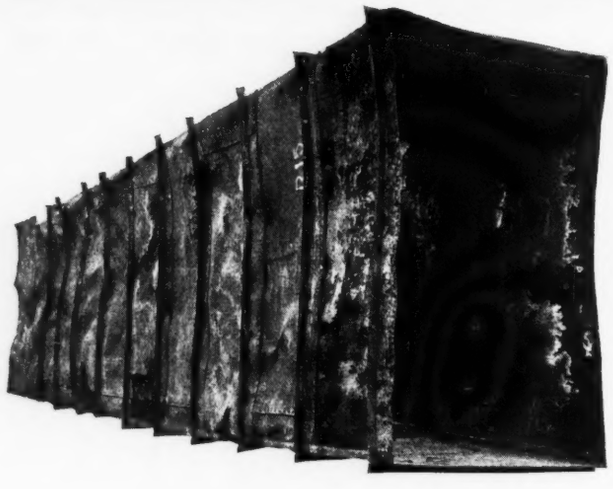
Cuts Down Fuel Cost— Improves Efficiency— Eliminates a Hazard



VIGILANT
Feed-Water
REGULATOR

Automatic, simple, accessible, unfailing, the "Vigilant" Feed-Water Regulator gets better steam production from the boiler to which it is attached, by holding the water level more perfectly constant than human attention can possibly do. The steadying of operation thus effected results in lower fuel cost. And the serious hazard that attends uncertain ups and downs of water level is definitely removed. Ask for Bulletin 2514, also Catalog of Chaplin-Fulton Regulators for all needs of pressure control.

THE CHAPLIN-FULTON MFG. CO.
28-40 Penn Avenue Pittsburgh, Pa.



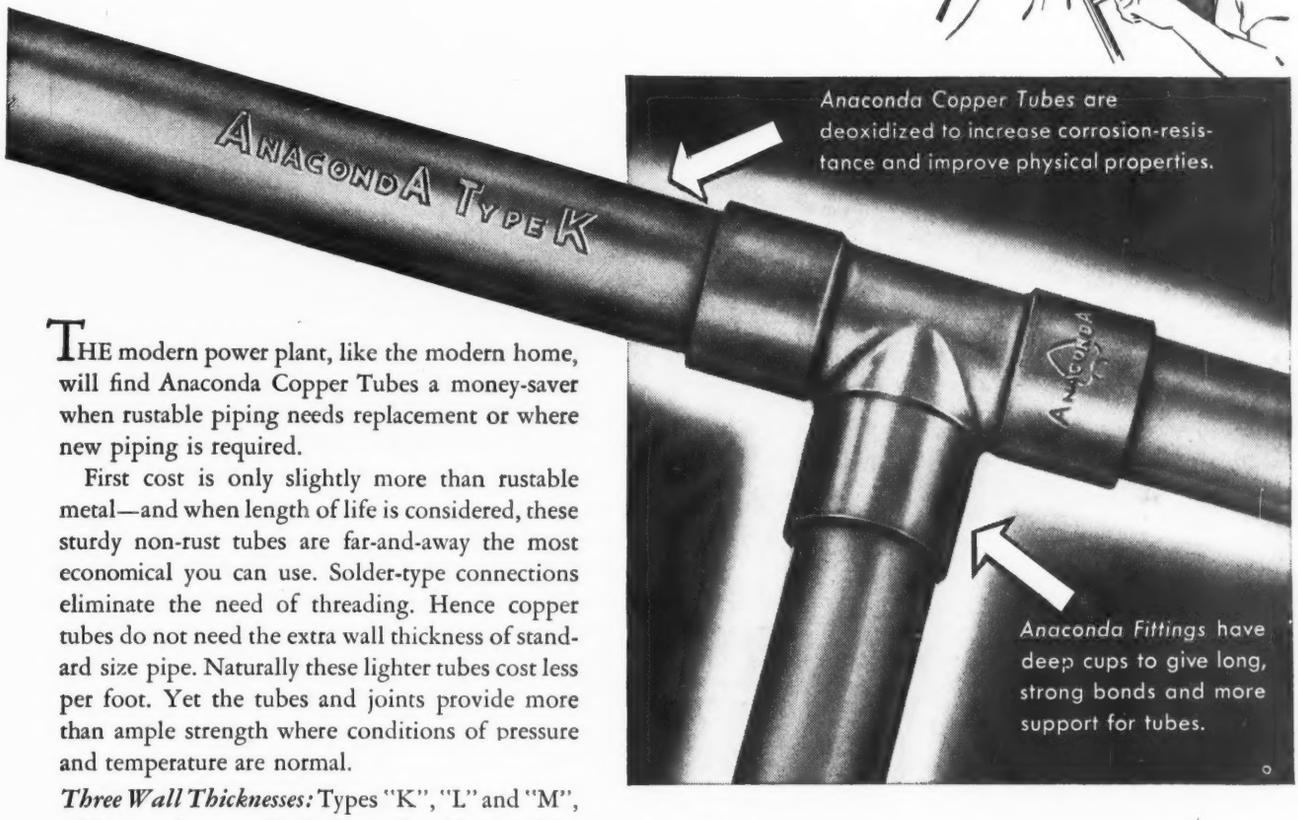
*Connery's Improved Accordion Type Expansion Stiffener construction is air and moisture tight, buckle and warp proof. Let us tell you more about it.

This Can't Occur with CONNERY CONSTRUCTION*

THE above section, 6 ft. wide, 15 ft. high, was part of six breechings removed from plant of one of the large oil companies after only six years' service. Note how inequality of heat on reinforcing members has buckled and warped this breeching. Connery Improved Expansion Stiffener type, welded joint, breechings are now doing satisfactory duty on this job.

CONNERY CONSTRUCTION CO.
4000 North Second St. **Philadelphia, Pa.**

Low-cost COPPER TUBES answer the problem of pipe maintenance


ANACONDA TYPE K
Anaconda Copper Tubes are deoxidized to increase corrosion-resistance and improve physical properties.
Anaconda Fittings have deep cups to give long, strong bonds and more support for tubes.

THE modern power plant, like the modern home, will find Anaconda Copper Tubes a money-saver when rustable piping needs replacement or where new piping is required.

First cost is only slightly more than rustable metal—and when length of life is considered, these sturdy non-rust tubes are far-and-away the most economical you can use. Solder-type connections eliminate the need of threading. Hence copper tubes do not need the extra wall thickness of standard size pipe. Naturally these lighter tubes cost less per foot. Yet the tubes and joints provide more than ample strength where conditions of pressure and temperature are normal.

Three Wall Thicknesses: Types "K", "L" and "M", which conform to U. S. Govt. Specification No. WW-T-799 and A. S. T. M. Spec. No. B88-33.

A complete line of tubes, and both solder-type and flared-type fittings, is now furnished by The American Brass Company and readily available from supply houses throughout the country. Use this modern piping for:

Plumbing: Hot and cold water lines. Fire sprinkler systems.

Heating: Low pressure steam lines. Hot water lines. Fuel lines.

Refrigeration and Air-Conditioning: Refrigerant circulation lines. Humidifying apparatus.

Mechanical Uses: Pressure lubricating systems. Hydraulic pressure lines (low pressure). Circulating lines for lubricants. Low pressure steam and air lines. Pump equipment. Fluid conveying lines.

Process Uses: Pipe lines for Breweries, Distilleries and Wineries; Textile Mills, Paper Mills, Sugar Mills, Chemical Plants, etc.

3752

Anaconda DEOXIDIZED Copper Tubes

ANACONDA from mine to consumer

THE AMERICAN BRASS COMPANY · GENERAL OFFICES: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities · In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

POWER

SERVICE SECTION

Machinery, Material, Equipment and Supplies for Power Plants

O-Z IMPROVED TACHOMETERS
with
FIXED READING DEVICE

Read Speeds at leisure: R.P.M., F.P.M. Also Speed Fluctuations. Send for catalog.

O. Zernickow Co.
21 Park Row New York

"EVACTOR" Steam Jet Vacuum Pumps.
"CHILL-VACTOR" Vacuum Refrigerating Units.
"FLEXO-DISC" Alloy Steel Expansion Joints.
"FILM-FLO" Deaerators and Desuperheaters.

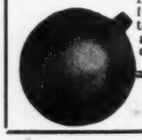
These trade names denote exceptional quality and dependability to users of Croll-Reynolds equipment in thousands of plants. Inquiries are solicited on these products and on all types of Boiler Feed Water Heaters, Condensers and Heat Exchangers.

CROLL-REYNOLDS ENGINEERING CO., INC.
17 JOHN ST., NEW YORK

CORRECT SPEEDS WITH TACHOMETERS
GEO. SCHERR CO.
126 Lafayette St. N. Y.

THE ORIGINAL
Tripp Metallic Packing
TRIPP METALLIC PACKING CO.
BOSTON MASS.

Seamless Copper Floats That Save Money



Naugatuck Seamless Copper floats for receivers, steam traps, separators, etc., are tested to 300 lbs. and are guaranteed for one year. Write for prices.

NAUGATUCK MFG.CO.
460 North Main St., Naugatuck, Conn.

THE HOLLY GRAVITY RETURN SYSTEM
NO MECHANISM
Can one hundred feet of well covered pipe get out of order? Yet, by this simple means we close up your high pressure drips with your boilers. Let us advise you how to be waste and trouble free.
Send for Descriptive Literature
RUSSELL B. HOBSON, Great Notch, N. J.

KERLOW
Gratings, BOLDEJ Safety Steps, Bridge Paving and Floor Armor.
Write for Catalog
KERLOW STEEL FLOORING CO.
228 Culver Ave., Jersey City, N. J.

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Asheville North Carolina

THE power plant executives who, with the help of sound engineering council, carefully scrutinizes every department of the plant with the result in mind of being thoroughly modern as to materials, equipment, operating methods, maintenance and management—that man is headed in the right direction.

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Established 1909
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ENGINEERS—CONSTRUCTORS
Steam and Hydraulic Power Plant Design and Construction, Investigation and Studies of Power and Steam Problems.
Reports and Appraisals
80 Broad St., New York

POWER

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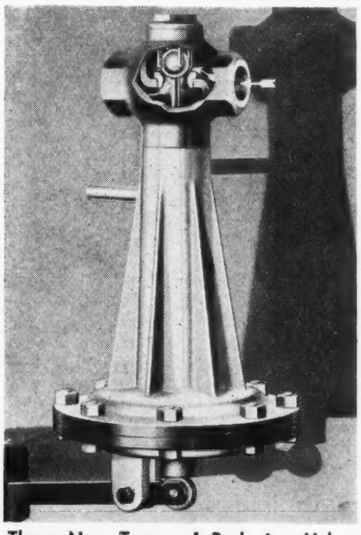
Machinery, Material, Equipment and Supplies for Power Plants



Three New Types of Reducing Valves

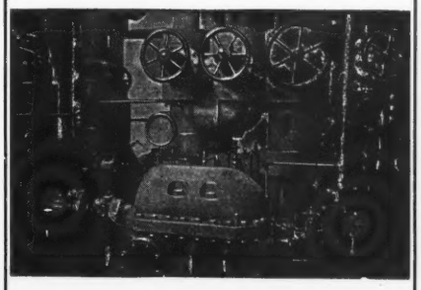
Tight Closing, Greater Capacity Stainless Steel Ball and Seat Closer Regulation

Send for Bulletin No. 361S.

KLIPFEL MFG. CO.

2645 W. Harrison St. Chicago, Ill.

WHEN YOU NEED GASKETS



We manufacture or fabricate all types of gaskets for power plants and can duplicate any type you need in any material.

★ BOILER GASKETS
★ WILCOX GASKETS
★ IMMEDIATE DELIVERY

Large stocks of boiler gaskets and materials carried, ready to ship at once. We are within 24-hours shipping time of all plants in the country. Prices are right. Write for catalog and quotations.

CHICAGO-WILCOX MFG. CO.

7701 AVALON AVENUE
CHICAGO, ILLINOIS

COMPRESSED AIR

Your Guarantee of a Reliable, Efficient Air or Gas Compressor is the Word

SULLIVAN

on the name plate

SIZES AND TYPES FOR EVERY NEED OF INDUSTRY

SULLIVAN MACHINERY COMPANY
Michigan City, Ind.
CHICAGO, ILL. NEW YORK, N. Y.

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1. **PERMITS** inspection of a furnace while in operation.
2. **PREVENTS** injury to the eyes during inspection.
3. **SAVES** fuel by making it easy to maintain high efficiency.
4. **PUTS** the goggles on the boiler, where they can always be found.
5. **INSURES** a clearer view that can be obtained with the naked eye.
6. **VISUALIZES** conditions in terms the firemen understand.

6 GOOD REASONS why your boilers need C-E-Z Fire observation windows

COMBUSTION SALES CO., INC., 4-8th Ave., N.Y.

"MONO" BOILER BAFFLES

HIGH TEMP. REFRACTORY CEMENTS

SANFORD C. SMITH REFRACTORIES, INC.
1715 Niagara St., Buffalo, N. Y.

COMPRESSED AIR DRYER

Costs Nothing to Operate

ELIMINATES OPERATING TROUBLES

Manufacturers and Engineers Sand Blast and Dust Collecting Equipment

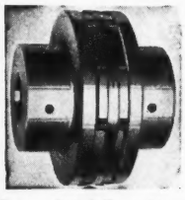
Cap. to 450 Ft.

The cause of many operating troubles in pneumatically operated equipment is moisture and oil in the compressed air supply. Cooling the air to a condensation temperature and expelling the oil and water by centrifugal action is the most scientific method known. Because the Ruemelin Compressed Air Dryer accomplishes this most thoroughly, it is being installed in ever increasing numbers in many leading industrial plants. Send for Bulletin 18-E.

RUEMELIN MFG. COMPANY

3850 N. PALMER ST., MILWAUKEE, WIS.

L-R FLEXIBLE COUPLINGS



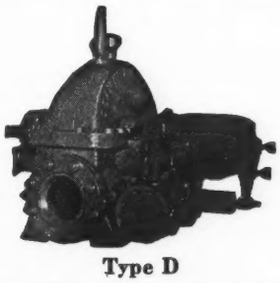
TYPE W

Transmits power smoothly. Preserves equipment. Absorbs shocks, torque, overload. No lubrication or servicing needed. Resilient. free floating cushions in plain sight. Easily removed. 1¾" to 14" bores. Special designs to order. Write

Patented and Pats. Pend

LOVEJOY FLEXIBLE COUPLING CO.

4976 WEST LAKE ST. CHICAGO, ILLINOIS



Type D

MECHANICAL DRIVE STEAM TURBINES

1 to 400 H.P.

RELIABLE EFFICIENT

DEAN HILL PUMP CO.

ANDERSON, IND.

STEAM TURBINES
PUMPING MACHINERY

MONARCH "INDUSTRIAL" NOZZLES

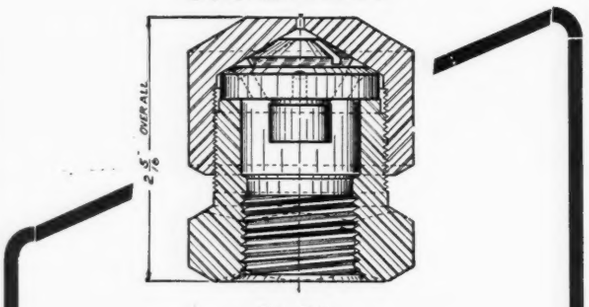


Fig. D-41

This industrial oil nozzle is made entirely of steel, the tip and disc being hardened to resist erosive action at high pressures. Using No. 6 fuel oil heated to 250 degrees F. operating pressures range from 200 to 300 lbs., and capacities (based on No. 2 furnace oil at 100 lbs.) from 17.3 to 180 G.P.H.

Catalog D

For industrial air washers, etc. Monarch non-clog nozzles giving an "umbrella" type spray are available in pipe sizes from 1/4" to 1", and capacities from 4.7 to 2050 G.P.H. at 40 lbs. pressure.

Catalog 6-A

MONARCH MFG. WORKS, INC.
2731 E. WESTMORELAND ST.,
PHILADELPHIA, PA.

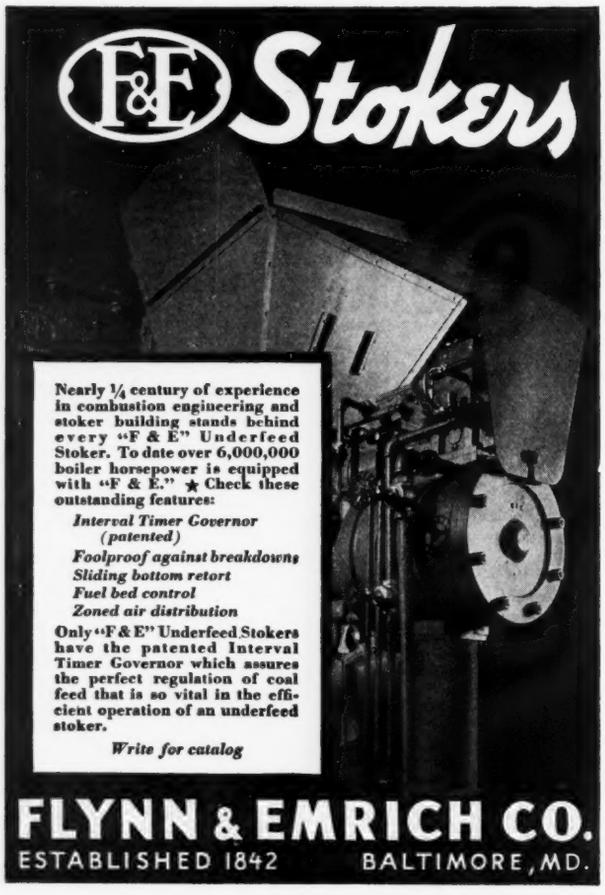
FRANCE
Metallic Packings of the better class

Ideal for superheated or saturated steam, ammonia, air or gas, for all pressures and operating conditions. Last 5 to 25 years. Sold on approval.

Write for catalog and list of users.

FRANCE PACKING COMPANY
6600 Tacony St., Philadelphia, Penna.

F&E Stokers



Nearly 1/4 century of experience in combustion engineering and stoker building stands behind every "F & E" Underfeed Stoker. To date over 6,000,000 boiler horsepower is equipped with "F & E." ★ Check these outstanding features:

Interval Timer Governor (patented)
Foolproof against breakdowns
Sliding bottom retort
Fuel bed control
Zoned air distribution

Only "F & E" Underfeed Stokers have the patented Interval Timer Governor which assures the perfect regulation of coal feed that is so vital in the efficient operation of an underfeed stoker.

Write for catalog

FLYNN & EMRICH CO.
ESTABLISHED 1842 BALTIMORE, MD.

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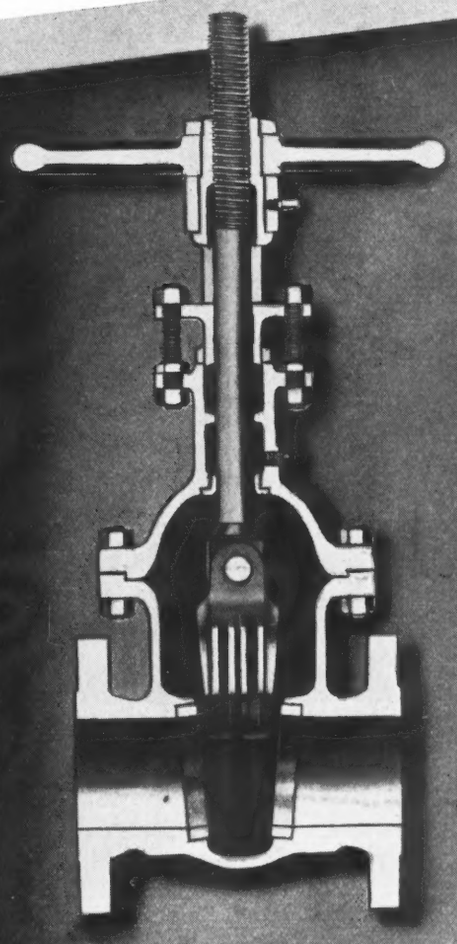
When it's a question of gate valves, Darling has the answer



Darling Gate Valves are unexcelled in

- **EASE OF OPERATION**
- **FREEDOM FROM REPAIRS**
- **ACCESSIBILITY OF PARTS**

Like all Darling Gate Valves, this Cast Steel Taper Seat Valve operates easily and closes tight! Its design assures easy, economical operation.

The one-piece, double-grooved alloy wedge, or gate, is split in the center to provide flexibility to compensate for varying conditions of pressure. The strong, hinged connection between stem and wedge permits accurate seating of the wedge without side strains. Ample thickness of metal in the side walls withstands erosion and corrosion.

Darling offers these valves in standard pressures made from regular carbon or stainless steel or other alloys with regular, stainless, or special alloy mounting for corrosive conditions.

DARLING VALVE & MANUFACTURING COMPANY
WILLIAMSPORT, PENNSYLVANIA

Representatives in:
NEW YORK • PHILADELPHIA • OKLAHOMA CITY • HOUSTON
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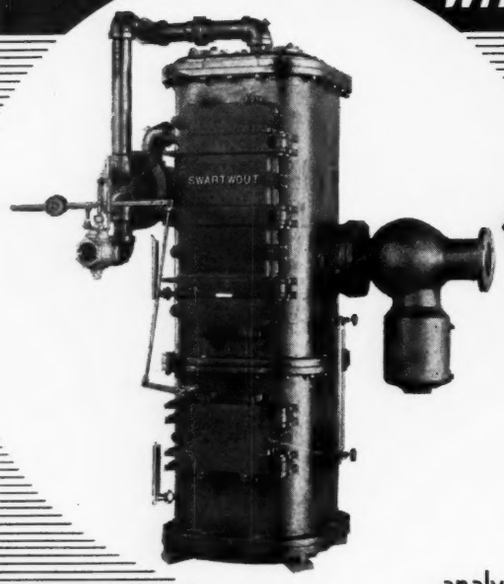
DARLING VALVES

GATE VALVES . . . CHECK VALVES
FIRE HYDRANTS

DEAERATING HEATERS
with Guaranteed Performance



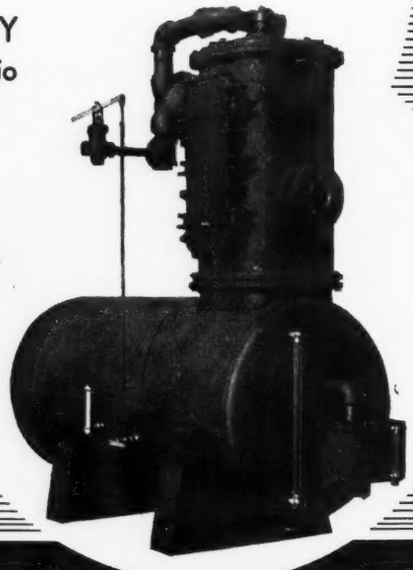
An all-machined joint Swartwout Heating and Deaerating Unit mounted on a cast iron standard storage section.

Let Swartwout Engineers Help You

analyze your deaerating heater problems—we will gladly quote you on a unit "tailored to your specific requirements". Send us your specifications today.

THE SWARTWOUT COMPANY
18501 Euclid Avenue, Cleveland, Ohio

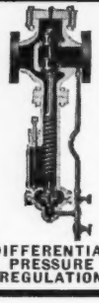
The same Swartwout Heating and Deaerating Unit mounted on a copper bearing steel storage tank to provide storage for intermittent condensate returns.



Swartwout
POWER PLANT EQUIPMENT

Also **Swartwout Power Plant Equipment** *for—*

FEED WATER REGULATION


DIFFERENTIAL PRESSURE REGULATION

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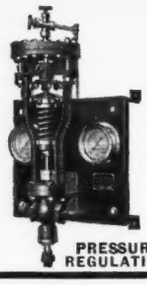
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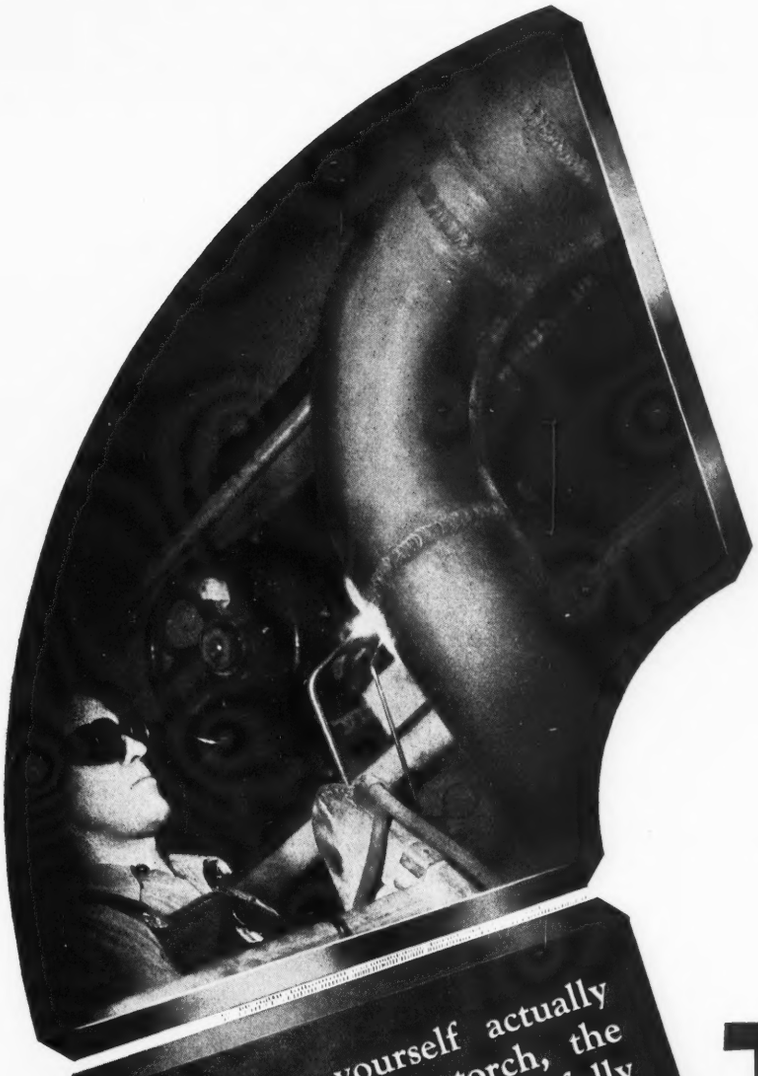

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Unless you yourself actually handle a welding torch, the chances are that you can't fully appreciate the value of Tube-Turns' dimensional accuracy... Only the welder himself knows how much time and gas is saved by using a fitting that *really matches* the diameter and wall-thickness of the pipe—how much *easier* it is to make strong, dependable welds with Tube-Turns. . . If there's any doubt of Tube-Turn superiority in your mind, *ask any welder*. That's all *we* ask. Tube-Turns, Incorporated, Louisville, Kentucky.

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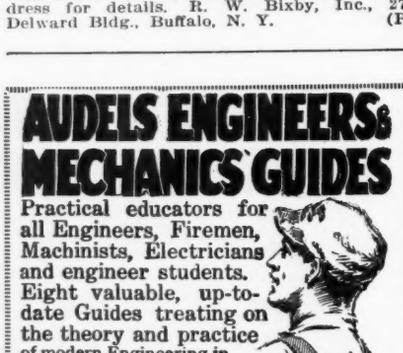
Practical educators for all Engineers, Firemen, Machinists, Electricians and engineer students. Eight valuable, up-to-date Guides treating on the theory and practice of modern Engineering in all its branches.



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POSITION VACANT

WANTED STATIONARY ENGINEER with first class Massachusetts unlimited license—capable of looking after an operating shift, including turbines, condensers, switchboards, etc. P-763, Power, 330 West 42nd Street, New York City.

POSITIONS WANTED

STEAM POWER PLANT operating engineer, nine years' experience with oil and natural gas fuels. Operation covers turbo-generators up to 20,000 kw and boilers up to 2,000 B.H.P. Experience covers supervision, test, operation and maintenance of complete steam-electric power plants, both condensing and extraction and exhaust type turbines. PW-737, Power, 520 No. Michigan Ave., Chicago, Ill.

TECHNICAL GRADUATE—age 32. Ten years' experience in operation, maintenance and supervision of Industrial and Utilities Steam Power Plants. Six years Chief Engineer of Industrial Power Plant. Good references. Willing to go anywhere. PW-754, Power, 330 West 42nd St., New York City.

MECHANICAL ENGINEER—Recent Cornell graduate desires opportunity for training in Power Plant operation and management. Limited experience testing auxiliaries such as turbines, condensers, steam jets, air compressors, blowers, and refrigeration units. PW-761, Power, 330 West 42nd Street, New York City.

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OPPORTUNITY OFFERED

SALESMEN WANTED for new patented automatic engineering utility, salable to all kinds of factories, institutions, railroad and steamship companies. Its automatic features eliminate inaccurate manual labor and is revolutionizing its particular field. Merits can be demonstrated in a few minutes. Single demonstrations more eloquent than a thousand words. Constant repeat business. Experience not essential. Permanent, dignified connection. Continental Asbestos and Refining Corp., 1 Madison Avenue, New York, N. Y.

OPPORTUNITY WANTED

MICHIGAN REPRESENTATIVE. Distributor of nationally known and advertised line of steam traps offers services to manufacturer of kindred lines for all or part of lower peninsula of Michigan. Have excellent contacts and am in position to give high class representation. RA-756, Power, 520 No. Michigan Ave., Chicago, Illinois.

FREE BULLETIN

REBUILT Power Equipment Catalog—56 pages, 4"x7", saddle stitched; classified, priced, illustrated and indexed. Write to Chicago Electric Co., 1320 W. Cermak Road, Chicago, Illinois.

WANTED

ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

OPPORTUNITIES!
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New and used equipment recently released from service by a number of electric and gas utility companies.

POWER PLANT EQUIPMENT
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Send for new list, . . . to

APPARATUS EXCHANGE
EBASCO SERVICES INCORPORATED
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WANTED

WANTED
One **electric dynamometer to absorb 100 brake horse power on internal combustion engine**, maximum speed, 3800 rpm. State price and details.
W-762 Power,
330 W. 42d St., New York City.

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GENERATOR
Used 220V, 60 cy., 3 p., 327 RPM, AC, 100 to 150 KW., engine type generator
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330 West 42d St., New York City

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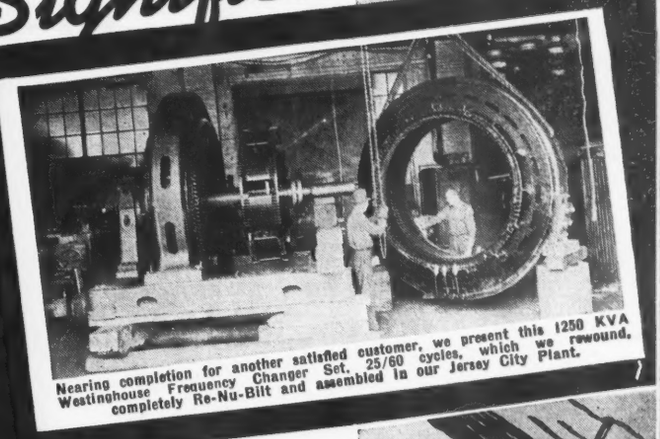


Nearing completion for another satisfied customer, we present this 1250 KVA Westinghouse Frequency Changer Set. 25/60 cycles, which we rewound, completely Re-Nu-Bilt and assembled in our Jersey City Plant.

Ready For Delivery & Fully Guaranteed

Motor Generator Sets

3 Phase—60 Cy.

2—1250/1500 KW West 3-Unit 250/125V consist of 2—625/750 KW DC Gen. 125V 600 RPM coupled each end of 1—1930 KVA syn. 2200V 600 RPM.

2—1000 KW West DC 600 V conn to 1440 HP syn. 4600 V 514 RPM.

1—1000 KW GE MPC DC Gen 250 V conn to 1400 HP syn. motor 6600/2300V 514 RPM.

1—1000 KW GE MPC DC Gen 600V conn to 1400 HP syn. motor ATI 4000V 514 RPM.

1—500 KW GE MPC DC Gen 250V conn to 700 HP syn. motor ATI 2300V 720 RPM.

1—400 KW GE MPC DC 550/550 V conn to 575 HP syn. ATI 4000 V 720 RPM

3—300 KW GE MPC DC Gen 600V conn to syn. motor **ATI 2300V 720 RPM.**

2—250 KW GE DC Gen 250V conn to syn. motor **ATI** 2300V **720 RPM.**

1—200 KW Ridgeway DC Gen 275V conn to 300 HP syn. motor 440/220V 900 RPM.

1—200 KW GE DC Gen 250V conn to syn. motor ATI 2300V 720 RPM.

1—175 KW West SK DC 275 V conn to 260 HP syn. 440 V 1200 RPM.

1—140 kw Cr Wh 125/250V 3-wire consist of 2—70 KW CCD comp interpole DC Gen 125V coupled each end of 200 HP Sq Cage 2300V 690 RPM.

1—100 KW West DC Gen 250V conn to syn. 2200V 1200 RPM.

1—60 KW GE 3-unit 125/250V consist of 2—30 KW CD DC Gen 125V coupled each end of 100 HP Sq. Cage 220V 1750 RPM.

3 Phase—25 Cy.

1—2000 KW Al Ch DC Gen 725V conn to syn. motor 12000/6600V **900 RPM.**

1—250 KW GE 3-unit 250/125V syn. consist of 2—125 KW interpole DC Gen 125V coupled each end of 1—390 HP syn. 6600V 750 RPM.

1—200 KW Cr. Wh. DC 250 v. conn. to Syn. 2200 v. 750 RPM.

1—40 KW GE DC Gen 125V conn to 60 HP Sq Cage 220V 1435 RPM.

Rotary Converters

1—500 KW GE HCC-8-500-1200 form P DC 600V AC 2300/4000V 3-ph 60 cy comp with trans.

1—50 KW Martin-North W. DC 90/115V AC 220V 1200 RPM 3-ph 60 cy.

Frequency Changer Sets

2500 KVA West 4000V 3-ph 62½ cy 750 RPM 360 amps dir conn 2800 HP syn. 2300V 3-ph 538 amps 750 RPM 25 cy.

700 KW GE ATI 2300V 3-ph 60 cy 750 RPM dir conn 1000 HP syn. ATI 6600V 3 ph 25 cy.

Transformers—60 Cy.

Kva	Make	Type	Voltage	Ph
2—4000	G.E.	WCT	79600x2300	3
3— 333	Maloney		13200x6600/2200	1
3— 300	G.E.	H	2400x120x240	1
3— 200	West.	SK	2300x460x230-115V	1
3— 100	Pittsburgh		2300x115/230	1
2— 75	Maloney	HE	2200x110/220	1

SYNCHRONOUS CONDENSERS

1500 KVA West. 2300/4000 V. 3 ph., 60 cy., 900 RPM. Complete with control dir. conn. exciters.

1000 KVA West. 2400 V. 3 ph. 60 cy. 900 RPM. Complete with control dir. conn. exciters.

A.C. Motors—3Ph—60 Cy.

Synchronous Type

H.P.	Make	Type	Volts	Speed
1500	G. E.	ATI	440/220	180
1400	G. E.	ATI	4000/2300	514
1000	West.		2300	900
450	West.		440/220	257
375	G. E.	ATI	2300	600
350	Cr. Wheeler		2300/440	720
300	G. E.	ATI	440/220	600
225	Elec. Mchy.	3-Brg.	2300/4150	450
200	West.		440	514
200	West.		2200/550	1800
100	West.		2300/550	1800
100	West.		2300/4150	1800

Slip Ring Type

H.P.	Make	Type	Volts	Speed
1500	West.	CW	2200	440
850	West.	CW	2200	710
500	Al. Ch.		2300/4000	500
450	West.	CW	2200	875/700
400	G. E.	MT-424	4150/2300	390
400	West.	CW	440	450
400	G. E.	MT-563	2200	1200
300	Al. Ch.	ANY	2200	585
250	G.E.	IM	2200	900
250	G. E.	MT-424Y	4000/2300	257
250	F. Morse	BV	2200	1200
250	West.	CW	2200	500
250	West.	CW	440/220	585
250	Cr. Wh.	128Q	440/220	435
225	G. E.		440/220	1800
200	West.	Cl	440/220	575
200	West.	CW	440/220	900
200	West.	CW	550	505
200	Cr. Wh.		440	900
200	G.E.	IM	440	1200
150	G. E.	I-P	440/220	900
100	G. E.		440/220	514
100	G. E.	I-M	550/220	700
90	Wagner	BR	440/220	650

Squirrel Cage Type

H.P.	Make	Type	Volts	Speed
1—250	West.	CS	2300/440	580
1—250	Al. Ch.		440/220	1200
1—200	West.	CS-876A	440/220	1160
1—200	G.E.	IE-13B	440/220	1760
1—150	Al. Ch.	AR-226	440/220	1200
1—150	G. E.	IK	2300/550	900
1—125	G. E.	KT-562	550	600
1—100	G. E.	I-K-15	440/220	720
1—100	G. E.	KT-543	440/220	1800

D.C. Generators

KW	Make	Type	Volts	Speed
1000	West.	Interpole	700	720
700	West.	Interpole	250	600
300	West.	Q.S.	250	600
300	West.	SK	250	525
250	G.E.	MPC	250	560/750
175	West.	MPC	250	1800
165	G. E.	MPC	300	375
165	G. E.	MPC	125	350
150	G. E.	DMC	250	550
125	G. E.	LC	250	1200
100	G. E.		250	375
75	G. E.	CD-123	115	1450
75	G. E.	RC-37	125	800

Diesel Engine Generator Sets

200 H.P., McIntosh & Seymore, 8 cylinder, V type, 550 RPM, dir. conn. 135 K.W., D.C., G.E. Gen. Can furnish A.C. Generator.

A.C. Generators

3 Phase—60 Cy.

KVA	Make	Type	Volts	Speed
1250	G. E.	ATB	440/220	180
937	Al. Ch. (2)		2300	450
750	West.		480	3600
375	West.	3-Brg.	2300	240
350	Cr. Wh.	(2 ph. 60 cy.)	2300	720
300	G. E.	ATB	480/240	600
250	G. E.	3-Brg. ATB	2300	600
250	West.	SK	1320	900
250	G. E.	ATB	2300	600
150	G. E.	ATB	2300/550	600
112	G. E.	ATB	2300/550	900
100	West. El.		480/240	900
100	G. E.		2300/550	900
75	G. E.	ATB	2300	900
75	West.		480/240	900
75	G. E.	TRB	2300	300
60	Roth		220	1200
45	West.		2300	514
22	G. E.	ETA	220	1800

D.C. Motors

Adjustable Speed—230 V.

H.P.	Make	Type	Speed
1—875	West.		480/720
1—550	West.		240/720
2- -500	G. E.	MPC	180/350
1—400	G. E.	MPC	160/300
1—400	West.	MILL	450/600
2—300	West.	SK	150/300
2—200	G. E.	DMC	300/600
1—125	G. E.	DMC	150/300
8—125	G. E.	DMC	300/900
1—125	West.	SK-210	225/900
3—100	Reliance	1050T	400/1200
1—100	West.	SK	475/1000
2—80	Diehl	K11-40	550/1100
6—75	Cr. Wh.	100H	350/900
1—75	G. E.	CD	575/870
1—60	West.	SK	107/160
2—60	El. Dy.	25-S	450/1200
5—60	El. Dy.	25-S	525/1050
2—50	West.	SK-190	225/600
1—50	West.	SK-160	600/1200
5—50	Cr. Wh.	EM	175/700
12—40/50	Cr. Wh.	H	175/700
2—40	West.	SK	120/240
1—40	West.		300/900
1—35	West.	SK	500/1500
1—32	West.	SK	300/1200
1—30	REL	262T	500/1500
1—25	West.	SK	275/1200
12—20	G. E.	LC	650/1950
1—20	G. E.	RF-12	500/1500
1—20	West.	SK	400/1200

Gear Reduction Sets

Unused 1250 H.P., Falke, type S15, enclosed gear, 145 teeth, 25" face, pinion 32 teeth, ratio 4.53 to 1, two fly-wheels on double extended high speed shaft, each 106" dia., 12¾" face, 19" rim, total weight approx. 135,000#.

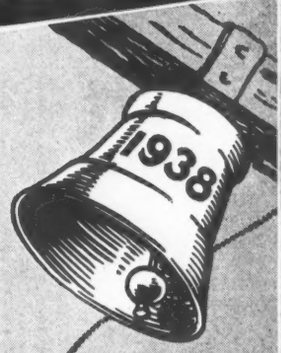
1000 H.P., Lewis Fdy & Machine Co., enclosed gear, 222 teeth, pinion 17 teeth, ratio 13/1, 430/34 RPM, 2 fly-wheels on high speed shaft, each 7'9" dia., 9" face, 14" rim.

Centrifugal Pumps

2500 GPM, DeLaval Type 10, 159', 75-lb., 10", S. Stage, D. Suction, dir. conn. to 150 HP G.E. Slip Ring, 1750 RPM, 440 V., 3 ph., 60 cy., with con

2100 GPM Worthington Pump, Size 8-CL-BS. 130 head, coupled to 100 HP West. Slip Ring type CW-752-C. 220 V. 1160 RPM, 3 ph., 60 cy.

3500 GPM Delal Type 150 MP 10" 130.5 Head 3 ph. 60 cy. with dir. conn. exciter, with control coupled to 150 HP. AC Motor. 2300 V. 1800 RPM



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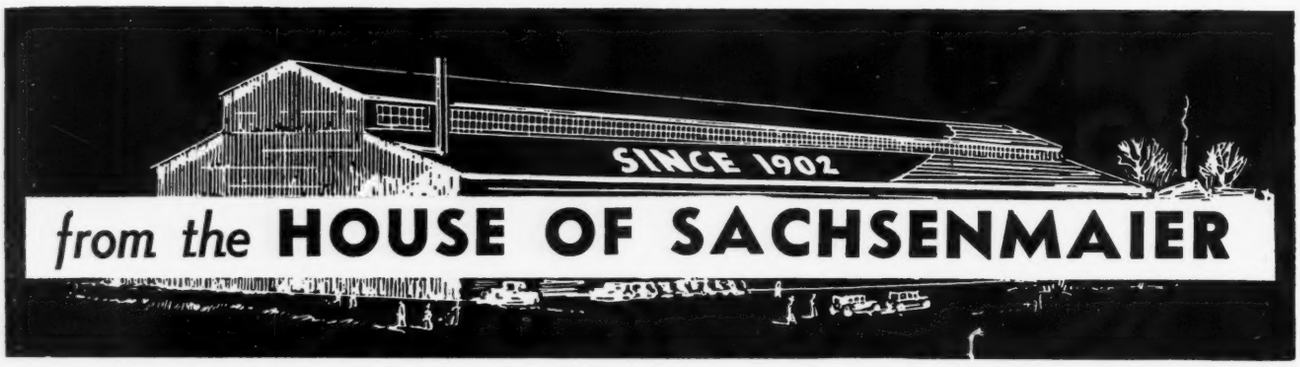

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DIRECT CURRENT UNITS

1—150 250 volt, 225 rpm, Gen. Elec., type MPC generator to a Skinner unaflow engine, 18x20, designed for 150 lbs. steam condensing and non-condensing.

1—Skinner unaflow engine built in 1935, designed for a 200 KW. generator, cylinder 21x21, side crank, with full floating piston, 200 rpm, 150# steam condensing or atmospheric exhaust.

1—300 Westgh. for direct connection.

TURBO GENERATORS

1—Revolving field for a 1250 KW, 3600 rpm, Gen. Elec. rigid frame turbo generator.

1—1500 KW, 3600 rpm, Gen. Elec. now nozzled for 140 lbs. steam, 15 lbs. back pressure, built 1925, used about 4 years. Can be used on steam pressures up to 300 lbs., 200 deg. superheat, 25 lbs. back pressure.

1—1875 KVA (1500 KW) 2 phase, 60 cycle, 2300 volt, 3600 rpm, Gen. Elec. turbo generator, 3 stage.

1—1250 KVA (1000 KW) 2 phase, 60 cycle, 2400 volt, 3600 rpm, (can be connected 3 phase) Gen. Elec. turbo generator, Turbine has extraction opening.

2—937 KVA, 750 KW, 3 phase, 60 cycle, 2300 volt, 3600 rpm, Gen. Elec. non-condensing with direct connected exciter designed for 160 lbs. steam, 20 lbs. back pressure. Never used.

1—937 KVA, 750 KW, 3 phase, 60 cycle, 480 volt, 3600 rpm, Gen. Elec., 130 lb. extraction type, with switchboard and 2000 sq. ft. surface condenser.

1—375 KVA, 2300 volt, 3 phase, 60 cycle, 900 rpm, Westgh. generator, #4199851, connected through a reduction gear to a Westinghouse steam turbine #12135, with 800 sq. ft. condenser with motor driven pumps and switchboard.

1—250 KVA, 3 phase, 60 cycle, 600 volts, 900 rpm, Westg. with direct connected exciter, connected through reduction gear to a Westgh. steam turbine.

1—250 KW, 250 volt, d.c. Gen. Enec. generator to a Gen. Elec. non-condensing turbine.

1—100 KW, 3 phase, 60 cycle, 240 volt, 3600 rpm, Gen. Elec. condensing turbo generator with direct connected exciter.

1—100 KW, 3 phase, 60 cycle, 240 volt, 3600 rpm, Gen. Elec. generator with direct connected exciter only.

1—100 KW (125 KVA) 3 phase, 60 cycle, 2300 volt, 3600 rpm, to a Gen. Elec., 3 stage, type L25, condensing, Gen. Elec. turbine, with direct connected exciter.

1—100 KW, 250 volt, 3 wire, D.C. Burke generator, 100 amp. in neutral, 1400 rpm, direct connected to a 160 HP, Midwest turbine designed for 100 lbs. steam, 15.2 absolute exhaust. Turbine built by Midwest Engine Works.

1—50 KVA, 220 volt, 2 phase, 60 cycle, 1200 rpm, Burke, with direct connected exciter to a Kerr Economy turbine.

2—25 KVA, 208/120 volt, 3 phase, 60 cycle, 3600 rpm, Burke generators with direct connected exciters, (no turbine) ball bearing.

CONDENSERS, ETC.

1—2000 sq. ft. Worthington surface condenser.

1—3000 sq. ft. C. H. Wheeler condenser.

1—5200 sq. ft. Alberger condenser.

1—#11, Westgh. LeBlanc jet condenser, turbine driven.

1—#14, Westgh. LeBlanc jet condenser, turbine driven.

1—12" Cochrane back pressure valve.

MOTOR GENERATOR SETS

See Rotary Converters

Compound Wound Unless Otherwise Noted

1—10 KW Balancer Set, consisting of 2-5 KW, 125 volt, 1500 rpm, type CVC-112, Gen. Elec. generators.

1—125 KW, 125 V., 1200 rpm, type RC-37A, Gen. Elec. to a 190 HP, 550 V., 1200 rpm, type ATI, 3 ph., 60 cy., Gen. Elec. synchronous motor with A.C. & D.C. panels.

1—100 KW, 250/275 V., 1200 rpm, type 15E06 Ridgway to a 150 HP, 2200 V., 1200 rpm, 3 ph., 60 cy., type 2-QT1D Ridgway syn. motor with A.C. & D.C. panels.

1—100 KW, 250 V., 720 rpm, type RC-38, Gen. Elec. to 150 HP, 3 ph., 60 cy., 440 V., 720 rpm, type I-15K, Gen. Elec. induction motor with starting equipment & switchboard panel.

1—65 KW, 125 V., 1160 rpm, type RC-35, direct connected to a 100 HP, 3 ph., 60 cy., 440 V., 1160 rpm, type KT, Gen. Elec. motor with panel and starter.

1—50 KW, 125 V., 1150 rpm, type SK-153L, Westgh. to a 75 HP, 220 V., type CS-662C, Westgh. motor with compensator & rheostat.

1—50 KW, 125 V., 1200 rpm, type DLC-203A, shunt wound, Gen. Elec. to a 75 HP, 220 V., 1200 rpm, type IQ, form K, Gen. Elec. motor.

1—50 KW, 125 V., 1200 rpm, type SK-150, compd., Westgh., to a 75 HP, 2200 V., 1200 rpm, type 123-AQ, Crocker-Wheeler motor.

1—30 KW, 24 V., 675 rpm, American Giant, type G, size GM, to a 50 HP, 220 V., 675 rpm, 3 ph., 60 cy., Crocker-Wheeler motor on a common cast iron base. Separately excited by 220 or 110 V. direct current. Above can be made 2500 amp., 12 V.

3 PHASE, 60 CYCLE, SLIP RING MOTORS

Qu.	H.P.	Make	Type	Speed
1-	25	Gen. Elec.	MT-336	680
1-	25	Gen. Elec.	MT-513	1720
1-	25	Gen. Elec.	MT-342	600
1-	25	Gen. Elec.	MT-322	1130
1-	25	Gen. Elec.	MT-522	1150
1-	25	Lincoln	HXI	850
1-	25	Westgh.	MW	680
1-	30	Gen. Elec.	MT-332	850
1-	30	Gen. Elec.	MT-526	1150
1-	35	Lincoln	HXJ	900
1-	38	Gen. Elec.	IM	1145
1-	40	Gen. Elec.	MT-332	1155
1-	40	Gen. Elec.	MT-336	1165
1-	40	Westgh.	CE-654C	1160
1-	50	Gen. Elec.	MT-356	575
1-	50	Westgh.	HF	1145
1-	50	Gen. Elec.	MT-346	870
1-	50	Westgh.	CW	870
2-	55	Gen. Elec.	IM	565
2-	60	Gen. Elec. to single drum Mundy hod hoists	MT-5536	900
2-	75	Gen. Elec.	I-14M	720
1-	75	Westgh.	CW-868	600
1-100		Allis-Chalmers	ANY	1750
1-100		Gen. Elec.	IM	865
2-100		Gen. Elec.	IM-16	435
1-100		Gen. Elec.	IM	1170
2-125		Gen. Elec.	IM	580
1-150		Gen. Elec.	15AIM	705
1-200		Fynn Welchsel	127-RN-35Y	720
1-200		Gen. Elec. 3156	1-17A form M	435
1-200		Westgh. 3 bearing	CW	500
1-250		Crocker-Wheeler	SR-27QB	585
1-400		Westgh. 3 bearing	CW-1108	500

3 PHASE, 60 CYCLE MOTORS SQUIRREL CAGE

Qu.	H.P.	Make	Type	Speed
1-	30	Westgh.	CCL	840
1-	30	Westgh.	CCL	1120
1-	30	Westgh.	CS	1160
1-	30	Westgh.	CS-574A	1160
1-	30	Triumph	12BS	860
1-	30	Westgh. ball bearing	CS-5670	1160
2-	30	Wagner	19T-RM	860
1-	35	Gen. Elec.	IK	900
1-	40	Gen. Elec.	KT-332	1155
1-	40	Gen. Elec.	KT-336	1165
1-	40	West. Elec.	KT-332	1155
1-	40	Gen. Elec.	KT-326	1160
1-	40	Westgh.	CS	870
1-	40	Westgh.	CCL	1120
1-	40	Westgh.	CS	1200
2-40/60/80		Gen. Elec.	I 900/1200/1800	
2-	50	Crocker-Wheeler		670
2-	50	Gen. Elec.	IK	1800
1-	50	Gen. Elec.	KT-333	1750
1-	50	Gen. Elec.	KT-552	420
2-	50	Gen. Elec.	KT-346	900
1-	50	Gen. Elec.	KT-342	900
1-	50	Gen. Elec.	KT-542	900
1-	50	Gen. Elec.	KT-356	580
1-	50	Gen. Elec.	KT-552	580
1-	50	Gen. Elec.	IK	1800
3-	50	Gen. Elec.	KT-336	1165
1-	50	West. Elec.	KT-346	870
2-	50	Westgh.	CS	1170
1-	50	Westgh.	CS	870
1-	50	Westgh.	CS-646A	870
1-	50	Westgh. sealed sleeve	CS-642C	1150
1-	60	Westgh. sealed sleeve	CS-856-C	435
1-	75	Crocker-Wheeler	124Q	690
1-	75	Ideal	350A	870
1-	75	Gen. Elec. stator only unused	1-14M	600
1-100		Allis-Chalmers	AN	690
1-100		Westgh.	CS-752C	1160
1-100		Gen. Elec.	IK	1160
1-100		Westgh. with belted exciter	Syn.	900
1-120		Westgh.	CS	870
1-150		Crocker-Wheeler	AQ125	690
1-150		Fairbanks-Morse	B	690
1-150		Gen. Elec. syn. direct connected exciter	ATI	600
1-200		Fynn Welchsel	127-RN-35Y	720
1-200		Gen. Elec.	IK	1200
1-200		West. Elec.	I	575
1-200		Westgh.	CS	580
1-225		Electric Machy. rewound for	Syn.	360
1-225		Electric Machy.	Syn.	360
1-220		Gen. Elec. .8 P.F. with belted exciter	ATI form PB	900
1-350		Westgh. NEW—stator and rotor only	Syn.	200
3-400		Westgh. 3 bearing	CS	500
1-2100		Gen. Elec., synchronous, with shaft, 1 bearing and ½ coupling, P.F. .8	ATI	514

A.C. GENERATORS

1—.4 KW, 115 volt, 1500 rpm, 60 cycle, 1 ph., 50 cy., self excited. Electric Specialty Co.

1—5 KVA, 220 Volt, 3 phase, 60 cycle, 1200 rpm, Kohler Electric plant, model 5A51. Like new. Reported 3½ years old.

1—10 KVA, 3 phase, 60 cycle, 220 volts, 600 rpm, type TAB, Gen. Elec. revolving field, with belted exciter with rails, pulley and rheostat.

2—10 KVA, 3 phase, 60 cycle, 220 volt, type ATB-7522, Gen. Elec. Generator only, 1200 rpm.

2—25 KVA, 20 KW, .8 P.F., 3 phase, 60 cycle, 240 volt, 450 rpm, type ATI-6184B, Gen. Elec. generators consisting of stator and rotor only with exciters, belted.

2—25 KVA, Burke, 208/120 volt, 3600 rpm, 70 A., 3 phase, 60 cycle, type ACR 1.4, with direct connected exciters, .625 KW, 125 volt, 5 A., 3600 rpm, shunt, ball bearing.

1—25 KW, Gen. Elec., 3 ph., 60 cy., 220 volt, 720 rpm.

2—31.3 KVA, 25 KW, .8 P.F., 3 phase, 60 cycle, 240 volt, 450 rpm, type ATI-6184-B, Gen. Elec. generators consisting of stator and rotor only, with exciters, belted.

1—50 KVA, .8 P.F., 3 phase, 60 cycle, 480 volt, 1200 rpm, Westgh. with 2.5 KW, type SK, direct connected exciter with base, pulley and exciter rheostat.

1—50 KVA, 3 phase, 60 cycle, 220 or 440 volt, 1800 rpm, Gen. Elec., type TS-7542 with belted exciter with rails, pulley and rheostat.

1—50 KW, 3 phase, 25 cycle, 1500 rpm, Gen. Elec.

1—62½ KVA, 240 volt, 1200 rpm, 2 phase, 60 cycle, Ridgway with rails, pulley and belted exciter with rails, pulley and rheostat.

1—75 KVA, 2 phase, 60 cycle, 240 volt, 277 rpm, Allis-Chalmers to 13x13 Fitchburg engine with belted exciter and switchboard.

1—100 KVA, 3 phase, 60 cycle, 220 volt, 900 rpm, Westgh. with rails and pulley and a belted exciter with rails, pulley and field rheostat.

1—100 KVA, 3 phase, 60 cycle, 440 volt, 600 rpm, Westgh. with a type SK exciter with rheostat, slide rails & pulley.

1—100 KVA, 300 rpm, 3 phase, 25 cycle, .8 P.F., Westgh., type HR consisting of stator & revolving field only.

1—150 KVA, 3 phase, 60 cycle, 440 volt, 200 rpm, Westgh. for direct connection. In original crate consisting of stator and rotor only.

1—156 KVA, 220 volt, 60 cycle, 2 phase, 257 rpm, Allis-Chalmers to a 14x16 Skinner unaflow engine, condensing type, including 9 KW, 120 volt, belted exciter.

1—180 KVA, 480 volt, 2 phase, 60 cycle, 225 rpm, Gen. Elec. generator connected to an 18x20 Ames engine.

1—225 KVA, 1 P.F., 180 KW, .8 P.F., 3 phase, 60 cycle, 2300 volt, 900 rpm, type ATB, form PB General Elec. with belted exciter with rails, pulley and field rheostat.

1—250 KVA, Allis-Chalmers, 3 bearing, 2 phase, 60 cycle, 240 volt, 600 rpm, with direct connected exciter.

1—325 KVA, 260 KW, 3 phase, 60 cycle, 240 volt, 200 rpm, Allis-Chalmers with direct connected exciter, connected to a 21x22 Skinner Universal unaflow engine, with tail rod designed for 150 lbs. steam condensing, or 5 lbs. back pressure.

1—400 KVA, 240 volt, 3 phase, 60 cycle, 150 rpm, Westgh. generator direct connected to a 26x30 Erie Ball, 4 valve engine with type SK exciter.

1—600 KVA, 3 phase, 60 cycle, 600-2300 volt, 400 rpm, Gen. Elec. generator with shaft and 2 outboard bearings.

WHAT HAVE YOU FOR SALE?

GEORGE SACHSENMAIER CO., INC.

8403 HEGERMAN STREET HOLMESBURG, PHILA., PA.

MOTORS A.C.

2 and 3 Phase Slip Ring

D.C.

115 Volts

HP.	Make	Type	RPM
90	Gen. Elec.	DLC	900
50	Gen. Elec.	RC	1765
40	Gen. Elec.	CD	400/600
35	Gen. Elec.	RC	1765
25	West.	SK	1400
20	Gen. Elec.	RC	1150
20	West.	SK	600

230 Volt

HP.	Make	Type	RPM
150	Gen. Elec.	RC	1750
100	West.	SK	625
75	Burke		1150
75	West.	SK	850
75	El. Dyn.	25S	700/1050
75	El. Dyn.	311N (2)	400
60	West.	SK	1150
60	Gen. Elec.	LC	900
60	West.	S	620
50	Gen. Elec.	CO-1810	725/1800
35	Gen. Elec.	DLC	875
30	West.	SK	1100
25	West.	SK	1800
20	Gen. Elec.	RC	1150
20	West.	SK	900
15	Gen. Elec.	RC29A	1700
15	Gen. Elec.	CD (5)	1150
15	Gen. Elec.	RC (2)	1150
15	West.	SK	1150
15	West.	SK	825/1650
15	West.	SK	850
15	West.	SK	700
15	Gen. Elec.	RLC	600/1800
10	Star	5B5	3600
10	Gen. Elec.	RC	1750
10	Gen. Elec.	CD (2)	1100
10	West.	SK (2)	850
10	Gen. Elec.	CD	575/1725
10	Gen. Elec.	RF	400/1600
7½	Sturtevant	TF	3500
7½	Gen. Elec.	CD	1750
7½	West.	SK	650
7½	Gen. Elec.	RF	600/1800
5.6	West.	SK60	500/1500
5	Gen. Elec.	SD (2)	1750
5	Gen. Elec.	RF	475/1425
5	Reliance	40TF	400/1600
3½	West.	SK	450/1800

550 Volt

18—1 to 66 HP, All Gen. El., Late Types.

HP.	Make	Type	RPM.
150	Gen. Elec.	lM	720
100	Gen. Elec.	MT	900
100	Fair.-Morse	BA	720
100	Fair.-Morse	HV	600
80	Gen. Elec.	MTC336	1200
75	West.	CW762	1200
75	Gen. Elec.	MT	1165
75	Gen. Elec.	MT	900
60	Gen. Elec.	MT346	900
60	Gen.El. 25 cy.	MTC5343	750
60	West.	CW-S116	300
50	West.	CW648A	1200
50	Gen. Elec.	MT346	900
50	Al. Chalmers	(2)	900
50/20	Wagner 2-speed		900/450
40	Star	VS69 (2)	1800
40	Cr. Wheeler		720
40	West.	CW	600
30/15	Gen. Elec. 2-s	pd.	1200/600
30	Gen. Elec.	MT336	900
30	Wagner	BR	600
25	Gen. Elec.	MT332	1200
25	Fair.-Morse	HV	900
25	Gen. Elec.	MQ326	900

SQUIRREL CAGE MOTORS

HP.	Make	Type	RPM.
350	Ridgeway	Synch.	900
220	Cr. Wheeler		720
175	Gen. Elec.	Synch.	600
150	Gen. Elec.	IK	600
125	Al. Chalmers	AR226	1800
125	Gen. Elec.	I-K	1200
100	Gen. Elec.	I-K	1200
100	Gen. Elec.	IK	900
100	West.	CCL	720
75	Ridgeway (2)		900
75	Gen. Elec. (2)	Synch.	1200
75	Gen. Elec.	KT352	900
75	Al. Chalmers	(2)	600
75	Gen. Elec.	IK	450
60	Ridgeway		3600
60	Gen. Elec.	KT346	1200
50	Gen. Elec.		900
50	West.	CS	1200
50	Howell		1200
50	Gen. Elec.	KT542 (2)	900
50	West.	CS (2)	900
50	Al. Chalmers		900
50	Wagner	BP	720
50	Gen. Elec.	IK	490
40	Diehl		1800
40	West.	CS	1200
30	Wagner	19TBP	1800
30	Diehl		1800
30	Gen. Elec.	KT332	1200
30	West.	CS	1200
30	Wagner	BP	1200
30	Gen. Elec.	KT342	720
25	West.	CS	1800
25	Gen. Elec.	KT336	600
20	Gen. Elec.	KT332	600

A.C.

SINGLE PHASE

98—¼ to 15 HP. All Makes. All Speeds.

SPECIALS

4—New 75 HP Westinghouse type CW Slip Ring Motors, Sealed Sleeve Bearings. 1200 RPM. Complete New Controls for each motor—All Duplicates.

PLATERS

1—5000 Amp Boissier Plating Generator—6 volts, 514 RPM—motor driven.

FREQUENCY CHANGERS

80 K.W. Gen. Elec. ATB, 100 cycles, 366 volts, 1200 RPM.
50 KVA. Gen. Elec. ITT, 90 & 120 cycles.
40 KVA. Gen. Elec. ITT, 90 & 120 cycles.
30 K.W. Gen. Elec. ITT, 90 & 120 cycles.
25 K.W. Gen. Elec. ITT, 90 & 120 cycles.
20 K.W. Gen. Elec. ITT, 180 cycles.
20 K.W. Gen. Elec. ITT, 90 & 120 cycles.
7 other frequency changers, 7½ KVA to 20 KVA, 90 to 180 cycles.

ELECTRIC HOISTS

A.C. & D.C.

1—5 Ton Gen. El. Sprague 220 V DC.
1—4 Ton Gen. El. Sprague 220 V DC.
2—3 Ton Gen. El. Sprague 220 V DC.
1—1 Ton Gen. El. Sprague 110 V DC.
1—½ Ton Shepard 220 V DC.
1—¼ Ton Gen. El. American 220 V DC.
1—¼ Ton Shepard 110 V DC.
1—3 Ton Euclid AC.
1—2 Ton Euclid AC.
1—1 Ton Euclid, AC.

MISCELLANEOUS

50 HP G.E. dynamometer.
20" to 48" A.C. & D.C. exhaust fans.
Switchboard meters & instruments A.C.&D.C.
Tirrell voltage regulators.
Switchboard & Starting equipment built to specifications.
5 KW Haltzer Cabat. high frequency generators 500 cycle, driven with 120 volt D.C. motor.
6½ KW Crocker Wheeler high frequency generator 500 cycle, driven by 120 volt D.C. motor.
100 Amp Hobart welder.

GENERATORS

A.C.

2 & 3 Phase

200 K.W. Gen. Elec. ATB, 720 RPM.
150 K.W. Allis Chalmers, 900 RPM.
150 K.W. Gen. Elec. ATB, 900 RPM.
112.5 KVA. Gen. Elec. ATB, 1200 RPM.
90 K.W. Gen. Elec. 900 RPM.
90 KVA. Triumph—360 RPM.
85 K.W. Westin. 720 RPM.
75 KVA. Gen. Elec. ATB, 1200 RPM.
30 K.W. West. 1200 RPM.
18 K.W. Gen. Elec. 1800 RPM.

Single Phase—110 Volts

3 KVA. direct connect. exc. 1800.
5 KVA direct connect. exc. 1800.
7½ KVA. direct connect. exc. 1800.
10 KVA. direct connect. exc. 1800.
15 KVA direct connect. exc. 1800.
20 KVA direct connect. exc. 1800.
110/220 Volts—3 wire A.C.
Single phase generators from 5 KVA. to 20 KVA. All above units mounted on steel base.

D.C.

Belted and Direct Motor Driven —125 Volts

100 K.W. Gen. Elec. 3 bearing synchronous Motor Driven.
50 K.W. Gen. Elec. DLC—1150 RPM.
45 K.W. Gen. Elec. 975 RPM.
40 K.W. Gen. Elec. CD, 1200 M.D.
40 K.W. West. SK—1150 RPM.
35 K.W. Ideal, 4 bearing, M.D.
25 K.W. Gen. Elec. 1200 RPM.
20 K.W. Ideal, 4 Bearing, M.D.
20 K.W. Gen. Elec. RC 950 RPM. (2)
15 K.W. Gen. Elec. 1800 RPM. M.D.

D.C.

250 Volts

Belted and Direct Motor Driven

250 K.W. Ridgeway, 500 RPM.
100 K.W. Synchronous Rotary Converter, 4000y 2300-6 phase, 1200 RPM.
100 K.W. Gen. Elec. 3 bearings, 900 RPM.
100 K.W. Gen. Elec. RC, 1050 RPM.
60 K.W. Westinghouse, 1000 RPM.
50 K.W. Gen. Elec. Synch, M.G.
50 K.W. Triumph, 900 RPM.
50 K.W. Elec. Dynamic, 600 RPM.
12 K.W. Continental 2 Bearing M.D.

300/2000 Volts

Belted and Direct Motor Driven

2000 volt Elec. Spec. 1.5 amp. M.D.
2000 volt Continental, 1.7 amp. M.D.
25 K.W. West. 500 volts, 50 amps.
20 K.W. Gen. Elec. 500 volts, 40 amps.
15 K.W. Elec. Dyn. 600 volts, M.D.
12½ K.W. West. 1000 volts, M.D.

Belted and Direct Motor Driven

Low Voltage under 110 Volts

3 volts Jantz Leitz 150 amps.
5 volts Chandeysson 25 amps.
12 volts Gen. Elec. 27 amps.
15 volts Westinghouse, 76 amps.
15.6 volts Gen. Elec. 40 amps.
18 volts Gen. Elec. 27.8 amps.
25 volts Gen. Elec. 100 amps.
26/31 volts Wotton 40/15 amps.
38 volts Gen. Elec. 885 amps.
42 volts Gen. Elec. 20 amps.
50 volts Westinghouse 32 amps.
55 volts Gen. Elec. 3.3 K.W.
55/110 volts Continental 25 amps.
64 volts Gen. Elec. 515 amps.
75 volts Westinghouse 1 amp.
45 other sets of various sizes and voltages.

27 Years Experience Behind our Guarantee

SAVE *with*

GUARANTEED REBUILT ELECTRICAL EQUIPMENT

Motors • M. G. Sets • Transformers

ARE ALL REBUILT IN OUR OWN SHOPS AND SOLD WITH OUR MONEY BACK GUARANTEE

—MOTORS—

220/440 Volts, 60 Cy. Squirrel Cage

1—300 H.P. Allis..... 900
1—200 H.P. G.E. 1-K.....1800
1—150 H.P. G.E. 1-K.....1800
6—100 H.P. G.E. KT.....1800
1—150 H.P. WEM CS.....1200
1— 75 H.P. WEM CS.....1800
3— 75 H.P. G.E. KT.....1200
2— 50 H.P. G.E. KT..... 900
2— 50 H.P. G.E. 1-K..... 900
3— 50 H.P. G.E. 1-K.....1200
1— 50 H.P. G.E. KT..... 720
1—100 H.P. G.E. KT..... 450
1—150 H.P. G.E. 1-K 16..... 450 2 ph.
2—100 H.P. WEM CS..... 900
1—150 H.P. Ridgway..... 680 BB
1— 50 H.P. Ridgway.....3600 BB
1— 25 H.P. G.E. KT.....3600 BB
2— 50 H.P. WEM CS..... 870
1— 60 H.P. G.E. KT.....1200
1— 60 H.P. G.E. KT..... 900
1— 75 H.P. WEM CS..... 900
3— 50 H.P. G.E. KT.....1800
1— 50 G.E. 1-K..... 720
4— 40 H.P. Ideal.....1800
2— 40 H.P. G.E. 1-K..... 690
3— 40 H.P. G.E. KT..... 690
3— 40 H.P. WEM CS..... 870
2— 40 H.P. Allis.....1200
1— 40 H.P. WEM CS.....1170
2— 40 H.P. WEM CS.....1750
2— 30 H.P. G.E. KT.....1800
2— 30 H.P. WEM CS.....1170
1— 35 H.P. WEM CS..... 870
1— 35 H.P. WEM CS.....1170
2— 30 H.P. WEM CS..... 870
1— 30 H.P. Allis.....1750
4— 25 H.P. Louis Allis.....1200 B. Bearing
1— 25 H.P. G.E. KT.....1200 B. Bearing
1— 25 H.P. G.E. FT.....1200
3— 25 H.P. G.E. KT..... 900
2— 25 H.P. WEM CS..... 900
1— 25 H.P. G.E. 1-K..... 900
1— 25 H.P. Robbins & Myers. 1200
1— 25 H.P. Wagner VCR.....1725 B. Bearing explosion proof linestart
1— 20 H.P. Sterling.....1750 B. Bearing explosion proof linestart
1— 10 H.P. Wagner VCR.....1200 B. Bearing explosion proof linestart
17— 15 H.P. G.E. KT.....1750 B. Bearing totally enclosed, fan cooled
11— 7½ H.P. G.E. KT.....1750
9— 5 H.P. G.E. Kt.....1200

2200 Volts

2—300 H.P. G.E. IE15B.....1200 Sq. cage
2—300 H.P. G.E. IE15B.....1200 Sq. cage
1—125 H.P. Allis..... 450 Slip ring
1—300 H.P. G.E. MT..... 600 3 bearing slip ring
1—200 H.P. Allis.....1800 Sq. cage
1— 40 H.P. Elec. Dyn.....1800Sq.cage BB
2— 50 H.P. WEM CS..... 900 Sq. cage
2— 50 H.P. G.E. MT..... 900 Slip ring
1— 50 H.P. G.E. 1-M..... 900 Slip ring
1— 50 H.P. G.E. MT..... 600
2—100 H.P. WEM CS.....1200 Sq. cage

440/220 Volts Slip Ring

1—300 H.P. MT..... 450
1—200 H.P. CW..... 500
1—200 H.P. Allis..... 580
1—150 H.P. CW..... 690
1—100 H.P. CW..... 690
1—100 H.P. CW..... 680 3 bearing
2—100 H.P. G.E. 1-M..... 570
1—100 H.P. G.E. 1-M..... 720
1—150 H.P. G.E. ITC..... 720 with full magnetic control
1— 75 H.P. CW..... 435
1— 75 H.P. CW..... 720
1— 75 H.P. CW.....1200
1—100 H.P. HF..... 580
1—100 H.P. HF..... 685
1— 75 H.P. CW.....1725
1— 60 H.P. MT.....1200
1— 60 H.P. MT..... 600
2— 50 H.P. MT..... 900
1— 50 H.P. CI..... 690
1— 50 H.P. CI..... 850
1— 30 H.P. CI..... 850 new
1— 75 H.P. HF..... 900
1— 50 H.P. CW..... 900
2— 50 H.P. MT..... 900
2— 40 H.P. CW..... 900
1— 30 H.P. MT..... 900
1— 30 H.P. CW..... 900
6— 20 H.P. MTC..... 900 new
1— 50 H.P. CW.....1200
1— 7½ H.P. CW..... 900
1— 10 H.P. CW.....1800
1— 10 H.P. CW.....1200
2— 10 H.P. 1-M.....1200
1— 5 H.P. CW.....1750
1— 7½ H.P. HF.....1800
1— 3 H.P. MT.....1800
1— 5 H.P. CI.....1120
1— 7½ H.P. CI.....1120
1— 50 H.P. MTC..... 580

ALSO, APPROXIMATELY 500 OTHERS IN VARIOUS RATINGS, ETC.

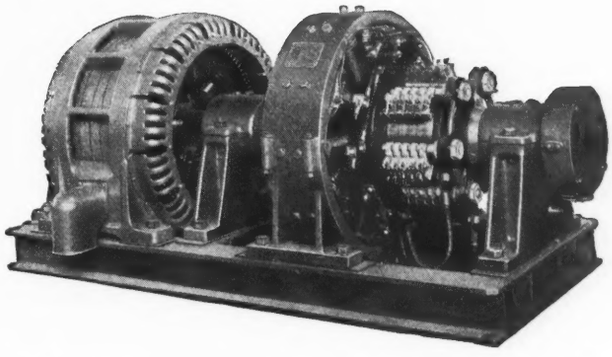
Phone, wire or write us your inquiries and send us a list of equipment you may have for disposal.

PENN ELECTRICAL ENGINEERING CO.

531 ASH STREET **Phone 8175 - 8176 - 8177** **SCRANTON, PENNA.**

CHICAGO'S LARGEST and MOST COMPLETE STOCK

TURBO GENERATOR SETS
MOTORS
M. G. SETS
GENERATORS



ENGINE GENERATOR SETS
PLATERS
WELDERS
COMPRESSORS

Single Motors or Complete Power Plants

A.C. MOTORS

3 phase—60 cycle

H.P.	Make	Type	RPM
1—1000	Crocker Wheeler	Synchronous	600
1— 800	Westinghouse	Slip Ring	360
1— 750	Electric Machinery	Synchronous	514
1— 550	General Electric	Synchronous	277
1— 500	Electric Machinery	Synchronous	514
1— 500	Allis Chalmers	Slip Ring	450
1— 400	General Electric	Slip Ring	600
1— 375	Electric Machinery	Synchronous	327
1— 350	Crocker Wheeler	Slip Ring	514
1— 350	General Electric	Synchronous	277
1— 315	General Electric	Synchronous	600
1— 300	General Electric	Slip Ring	1800
1— 300	General Electric	Slip Ring	1200
1— 300	General Electric	Slip Ring	514
2— 300	Westinghouse	Slip Ring	360
1— 250	Westinghouse	Slip Ring	1800
1— 250	General Electric (Vert.)	Slip Ring	1200
1— 250	General Electric	Slip Ring	600
1— 225	General Electric	Synchronous	600
1— 200	Fairbanks Morse	Slip Ring	1200
2— 200	Westinghouse	Squirrel Cage	1200
1— 200	Burke	Slip Ring	900
2— 200	Allis Chalmers	Slip Ring	720
1— 200	Westinghouse	Slip Ring	720
1— 200	General Electric	Synchronous	720
2— 200	General Electric	Slip Ring	600
2— 200	General Electric	Squirrel Cage	600
1— 200	Westinghouse	Slip Ring	514
2— 200	General Electric	Squirrel Cage	450
1— 195	Siemers	Slip Ring	3600
1— 150	Westinghouse	Slip Ring	1200
1— 150	Allis Chalmers	Squirrel Cage	1200
1— 150	General Electric	Slip Ring	900
1— 150	Westinghouse	Squirrel Cage	900
1— 150	Allis Chalmers	Squirrel Cage	720
1— 150	General Electric	Slip Ring	600
1— 150	Burke	Synchronous	600
2— 150	General Electric	Squirrel Cage	450
2— 150	General Electric	Synchronous	360
1— 125	Westinghouse	Slip Ring	720
1— 100	General Electric	Squirrel Cage	1800
1— 100	General Electric	Slip Ring	1800
1— 100	General Electric	Synchronous	900
1— 100	Westinghouse	Squirrel Cage	900
1— 100	General Electric (Vert.)	Slip Ring	900
2— 100	Crocker Wheeler	Slip Ring	720
1— 100	Lincoln	Squirrel Cage	720
1— 100	Allis Chalmers	Slip Ring	600
1— 100	General Electric	Slip Ring	360

A.C. GENERATORS

3 phase—60 cycle

KVA	Make	Type	RPM
1— 750	Crocker Wheeler		600
1— 500	Electric Machinery		514
1— 500	Ideal		400
1— 375	Electric Machinery		327
1— 375	General Electric	ATB	225
1— 300	General Electric	ATB	720
1— 200	General Electric	ATB	720
1— 175	Westinghouse		900
1— 150	General Electric	ATB	600
1— 92	General Electric		257

D.C. MOTORS

H.P.	Make	Volts	RPM
1—1000	Elliott	230	140/170
1— 325	Westinghouse	230	525
1— 200	General Electric	230	1200
1— 175	General Electric	230	860/1050
1— 150	General Electric	230	800/1000
1— 130	General Electric	230	720
1— 125	Chandeysson	230	1050/1250
2— 125	General Electric	230	850/1050
1— 125	Allis Chalmers	230	300/360
1— 125	General Electric	230	410
1— 115	General Electric	115	850
2— 112	Westinghouse	230	1750

MOTOR GENERATOR SETS

3 phase—60 cycle—A.C. Motors

2—1000 KW Westinghouse 600 volts
2— 750 KW Westinghouse 120/180 Volts DC
1— 600 KW Allis Chalmers 250 volts DC
1— 500 KW General Electric 600 Volts DC
1— 300 KW Allis Chalmers 250 Volts DC
1— 300 KW Allis Chalmers 600 Volts DC
1— 150 KW General Electric 250 Volts DC
1— 100 KW General Electric 250 Volts DC
1— 100 KW Allis Chalmers 120 Volts DC
1— 100 KW General Electric 125 Volts DC, with 3 Phase, 40 Cycle Synchronous Motor Drive
1— 75 KW General Electric 125 Volts DC
1— 50 KW Crocker Wheeler 125 Volts DC

ROTARY CONVERTERS

2—300 KW General Electric 1200 RPM, 60 Cycle to 600 Volts DC
3—250 KW Allis Chalmers, 500 RPM, 25 Cycle to 500 Volts DC

FREQUENCY CHANGERS

1—2500 KVA Westinghouse, 25/60 or 60/25 Cycles, 300 RPM
1—1000 KVA Allis Chalmers, 25/62½ Cycles, 375 RPM
2—500 KVA Westinghouse, 25/62½ Cycles, 750 RPM
1—450 KVA General Electric, 25/62½ Cycles, 750 RPM
1—150 KW General Electric 60/100 Cycles
1—100 KVA Westinghouse 60/180 Cycles
1—90 KW General Electric Adjustable Frequency Set, 60/120 Cycles, or 75 KW, 60/100 Cycles or 68 KW, 60/90 Cycles or 60 KW, 60/80 Cycles with 4-speed motor drive

PLATING GENERATOR SETS

1—4000/2000 Amp. Hansen Van Winkle, 9/18 Volts
1—4000/2000 Amp. Burke, 6/12 Volts
1—3500/1750 Amp. Bogue, 8/16 Volts
1—1350 Amp. Rochester, 7½ Volts

AIR COMPRESSORS

1—2600 CFM Sullivan Direct Driven by 450 HP Synchronous Motor
1—1220 CFM Bury, 30 lb. Pressure, belt driven
1—1100 CFM Bury, two stage, belt driven
2—1000 CFM Laidlaw Worthington Steam Driven
1—870 CFM Gardner Denver Two Stage, Direct Driven by 150 HP Synchronous Motor. New in November 1935.
3—382 CFM Chicago Pneumatic Two Stage Air-Cooled, 870 RPM, each Direct Driven by 75 HP Slip Ring Motor. New in 1936
1—340 CFM Sullivan Two Stage, Belt Driven

A.C. TURBO SETS

Condensing—3 phase—60 cycle

2—5000 KVA Westinghouse
1—5000 KVA General Electric
1—2500 KVA General Electric—Extraction
2—1250 KVA Westinghouse
1—1250 KVA General Electric—Mixed Pressure
2— 937 KVA Allis Chalmers
1— 625 KVA Westinghouse
1— 375 KVA Allis Chalmers
1— 312 KVA Kerr—Mixed Pressure
1— 125 KVA General Electric
1— 35 KVA DeLaval

Non-Condensing—3 phase—60 cycle

2—937 KVA General Electric
1—312 KVA Kerr
1—250 KVA General Electric
1—125 KVA Westinghouse

230 Volt Direct Current

1—1000 KW Westinghouse—Condensing
1— 300 KW General Electric—Non Condensing

A.C. STEAM ENGINE SETS

3 phase—60 cycle

1—750 KVA Nordberg Uniflow
1—675 KVA Chuse 4-Valve
1—400 KVA Filer & Stowell 4-Valve
1—200 KVA Murray 4-Valve
1—150 KVA Skinner Counterflow
1—112 KVA Ames Uniflow
1—100 KVA Murray 4-Valve
1— 85 KVA Ames Uniflow

D.C. STEAM ENGINE SETS

1—200 KW Murray Uniflow 250 Volts
1—100 KW Erie Ball 4-Valve 250 Volts
1— 75 KW Ames 250 Volt

MISCELLANEOUS

1—12,800 GPM Allis Chalmers, 70' Head, Motor Driven Pump
1—1500 GPM Pumping Engine, with Water Works Type Surface Condenser
1—4000 Sq. Ft. Surface Condenser
1—1000 GPM Fire Pump, Motor or Turbine Driven
1—125 KVA Oil Engine Generator Set
1—600 GPM Ingersoll Rand, 500' Head, Motor Driven Pump.

CHICAGO ELECTRIC COMPANY

1320 West 22nd Street, Chicago, Ill. • Canal 2900

OVER QUARTER CENTURY SATISFACTORY SERVICE

BUY NOW FOR FUTURE SAVINGS

THIS EQUIPMENT IS PRICED RIGHT—IS RIGHT—SAVE ON THE FIRST COST—SAVE FOR THE FUTURE

MOTORS

60 CYCLE MOTORS SQUIRREL CAGE

Amt	HP	Make	Volts	Speed
8—	5	West.	440	1200
2—	25	West.	440	600
1—	25	Cr. Wh.	440	565
2—	25	G.E. KT536	440	720
2—	30	West. CS	440	1200
12—	50	G.E.	440	1200
8—	60	G.E.	440	1200
1—	50	G.E. KT542	440	900
7—	60	G.E.	440	900
9—	75	G.E.	440	900
5—	75	G.E.	440	1200
7—100		G.E.	440	1200
1—100		F. Morse	2200	1800
1—	50	West. CS	2200	1800

60 CYCLE MOTORS SLIPRING

Amt	HP	Make	Volts	Speed
6—	30	West. CW	440	1200
2—	50	West. CW	440	1200
1—	75	Allis Ch. ANY	440	1200
2—	82	G.E.	440	450

25 CYCLE MOTORS SQUIRREL CAGE

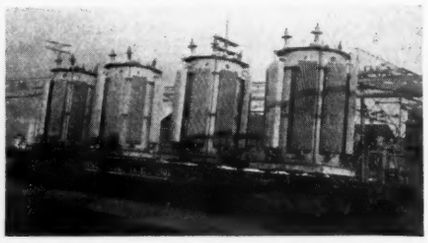
Amt	HP	Make	Volts	Speed
2—	50	G.E.	2200	750
2—	75	G.E.	2200	500
2—	50	G.E.	440	750
4—	50	G.E.	440	500
5—	75	G.E.	440	750
2—100		G.E.	2200	750
1—200		G.E.	2200	750
1—200		G.E.	440	750
100/200		G.E.	440	250/500

25 CYCLE MOTORS SLIPRING

Amt	HP	Make	Volts	Speed
4—	15	West.	440	500
3—	20	West.	440	500
1—	25	G.E.	2200	750
1—	30	West.	2200	750
2—	50	G.E.	440	750
1—	75	G.E.	440	750
1—100		G.E.	440	750

ABOVE IS ONLY A PARTIAL LIST

TRANSFORMER



SPECIALISTS

A RECENT SHIPMENT
4—1000 KVA 25 Cy. 22000/2300 V.

TRANSFORMERS

25 CYCLE
1— 50 KVA GE H 4600/115/230
4— 100 KVA GE H 4400/220/440
1— 150 KVA GE 2300/115/230
3— 200 KVA GE H 12000/220/440
3— 200 KVA GE 11000/220/440
3—1667 KVA GE H 23000/2300

60 CYCLE
2— 50 KVA Gen. Elect. 440/220
2— 50 KVA Pac. A 2300/4600/230/460
3— 75 KVA Kuhl. 440/220/440
1— 125 KVA Pittsbg 2300/115/230
3— 250 KVA Gen. Elect. 2300/230/460
3— 625 KVA West. 13200/2300
4—1667 KVA Pittsbg 22000/2200

Westinghouse Rotary Converter 200 KW 250 volts, direct current, 800 amps. complete with two 100 KVA 25 cycle, transformers and necessary panels

M G SETS
750 KW Generator 250 volts D.C. connected to 1100 H.P. 25 cycle, 3 phase, 2200 volt motor complete.

PUMP & MOTOR
Janesville 18" Double Suction Centrifugal Pump Capacity 6,950 GPM against 106' Head, direct connected to 250 H.P. G.E. motor 25/3/440/750 Synchronous complete.

DIRECT CURRENT MOTORS
Hundreds of D.C. Motors 115 and 230 volts. Write for complete list.

ROTARY CONVERTERS
150 KW Westinghouse 60 cycle to 115/230 volts D.C. transformers. A.C. and D.C. panels.
200 KW Westinghouse, 25 cycle to 250 volts D.C. transformers. A.C. and D.C. panels.

PLATING GENERATORS
2—2500 amp. 15 volt Jantz & Leist with exciters and panels.

WELDERS
300 Amp. U.S.L. 25 cycle motor drive
200 Amp. Lincoln 25 cycle motor drive
300 Amp. motor drive

WANTED TO BUY
200 KW Synchronous M G Set 115/230 V. D.C. 440/60/3
300 KW Synchronous M G Set 250 V. D.C. 220/60/3

We buy complete power plants for cash

We have just purchased and have in transit 3 carloads of Transformers and Motors all modern equipment, many items are new in original crates.

A Firm Built on a Foundation of Fair Dealing

Send for Complete List of Transformers
We have a complete stock of 10,000 Motors

WE OFFER TIME PAYMENT SALES

WRITE, WIRE OR PHONE YOUR INQUIRIES

ERIE ELECTRIC MOTOR REPAIR CO. INC.

112-124 CHURCH ST. Phone Cleveland 4758 Night—Call PA 4274 **BUFFALO, N. Y.**

WE BUY

★

POWER PLANTS in their entirety or individual units. Highest prices paid for desirable equipment. Let our expert engineers inspect your plant and submit our best proposition.

WE OFFER FOR SALE

★

MERCURY ARC RECTIFIERS
Automatic and Manually operated. 1200 KW Brown Boveri complete units. For immediate shipment. **Attractively priced.**

TURBO-GENERATOR UNITS:
60 cycle-3600 r.p.m.
200 K.W.
500 K.W.
1000 K.W.
2500 K.W.

ROTARY CONVERTERS:
G.E. and West. 25 and 60 cycle modern interpole machines.
300 K.W.
500 K.W.
1000 K.W.
1500 K.W.
2000 K.W.
3000 K.W.

TRANSFORMERS:
All capacities—outdoor type.

MOTOR-GENERATOR SETS:
200 K.W. to 1000 K.W.

ENGINE-GENERATOR UNITS:
75 K.W. Ridgeway units, 250 volts D.C.
2—200 K.W. G.E. Generators, 3 ph. 60 cy. 200 r.p.m. 2300 volts with engines.

SURFACE CONDENSERS:
1000 sq. ft. to 5000 sq. ft.

RAILS:
Various sizes. Complete with bars.

Full and complete details at unusually attractive prices, for quick disposition will be forwarded upon request.

H. E. SALZBERG CO. INC.

11 PARK PLACE, N. Y. C., Tel. REctor 2-1890-1-2-3
Established 1898

THE FINEST REBUILT EQUIPMENT MONEY CAN BUY

Ready For Immediate Shipment

Teletype Designation Union City, N. J. 1750

CHICAGO REP. HOWARD B. JOHNSON, 53 W. JACKSON BLVD.

MOTOR GENERATOR SETS

1—200-kw., 600-V., Westinghouse, synchronous.
1—200-kw., 125-V., G.E. Synchronous.
1—150-kw., 250-V., Westinghouse Synchronous.
1—125 kw., 250-V., G.E. Synchronous.
2—100-kw., 125-V., G.E. Sq. Cage.
1—100-kw., 125-V., G.E. Synchronous.
1—100-kw., 250-V., Westinghouse Synchronous.
1— 75-kw., 125-V., Crocker-Wheeler. Synchronous.
1— 75-kw., 250-V., G.E. Synchronous.
1— 50-kw., 125-V., G.E. Sq. Cage.
1— 50-kw., 250-V., G.E. Sq. Cage.
200-kw., 250-V., G.E. Synchronous.
30-kw., 125-V., Fairbanks-Morse, Sq. Cage.
25-kw., 125-V., Allis-Chalmers, Sq. Cage.
10-kw., 125-V., G.E. Sq. Cage.
1500 amp., 20-V., Bogue plating set.

TURBINES

1—500 kw., General Electric, 3 phase, 60 cycle, 480 volt bleeder.
1—500-kw., G.E., 3600 R.P.M., direct connected exciter, generator only.
1—400-kw., General Electric, non-condensing.
1—156 kva., Westinghouse, non-condensing.
2—100 kw., Westinghouse, 220 volt, 3 phase, 60 cycle non-condensing.
1—62½ kva., Allis Chalmers-Kerr, 3 phase, 60 cycle, 220 volt.
1—50-kw., 125-V., G.E.-Kerr Turbine Pump, 3500 gal. per min., 135 ft. head.

TRANSFORMERS

3—500-kva., Maloney, 4600/2300-460/230 volts.
1—400-kva., G.E. 2400/240-480 volts.
3—300-kva., 3-ph., Pittsburgh, 4800/2400/240/120-V.
4—300-kva., Pittsburgh, 4600/115/230 volts.
3—250-kva., General Electric, 2300/480 volt.
4—200-kva., Pittsburgh, 7800/220/110 volts.
2—150-kva., Westinghouse, 2300/230/115-V.
3— 75-kva., G.E., 2300/230/115 volts.
1—37½-kva., G.E., 240/120-V.
1—31½-kva., G.E., 440/110-V.
5—25-kva., Westinghouse Air Cooled, 440/220/220/110 V.
1—25-kva., G.E., 440/110-V.
1—25-kva., American, 220/220/110-V.
1—25-kva., G.E., 220/220/110-V.

SPECIALS

1—500 H.P., link belt, silent chain drive, pinion 23 teeth, gear 50 teeth, 8′ centers.
1—350 H.P., 100 RPM, General Electric synchronous motor.
1—75 KW, 220/440 volt, Vertical Engine Generator Set.
1—200 H.P., Westinghouse, type SK, 500 RPM, 550 volt motor.
1—200 H.P., G. E., 440 volt, 250 RPM, 25 cycle, slip ring motor.

4—21-kva., G.E., 440/110-V.
2—20-kva., Westinghouse, 440/220/110-V.
3—15-kva., G.E., 440/120-V.
4—15-kva., Westinghouse Air Cooled, 220/440/220/110-V.
1—10-kva., G.E., 440/220/110-V.

A.C. GENERATORS

720-kva., 514 r.p.m., 4000/2300-V., G.E. Syn. Condenser.
1—600-kva., 900 RPM, General Electric, 2300 volt, synchronous condenser.
1—500-kw., Westinghouse, 220/440 volts, 450 r.p.m.
1—400-kva., Westinghouse, 220/440 volt, 400 rpm.
1—375-kw., Westinghouse, 2300 volt, 240 rpm.
200-kva., 720 r.p.m., 220-V., G.E.
150-kva., 500 r.p.m., 2300-V., 25-cy., G.E.
150-kw., 450 r.p.m., 220-V., Westinghouse.
100-kw., 900 r.p.m., 220-V., G.E.
75-kva., 300 r.p.m., 2400-V., Westinghouse.
75-kva., 1200 r.p.m., 2300-V., G.E.
50-kw., 300 r.p.m., 2300-V., G.E.
42-kva., 1200 r.p.m., 2400-V., Elec. Machy.
2—7½-kw., 1800 r.p.m., 240 V., G.E.

D.C. MOTORS—230 Volts

1—750-hp., 600 r.p.m., Allis Chalmers.
1—240-hp., 550 r.p.m., G.E.
1—215-hp., 750 r.p.m., G.E.
1—125 hp., 850 r.p.m., G.E.
1—100-hp., 950 r.p.m., G.E.
1—100-hp., 900 r.p.m., G.E.
1— 60-hp., 1050 r.p.m., G.E.

D.C. GENERATORS

1—100-kw., 750 r.p.m., 125-V., G.E.
1—100-kw., 600 r.p.m., 125/250-V., G.E.
2— 75-kw., 1200 r.p.m., 125-V., Crocker Wheeler.
1— 75-kw., 550 r.p.m., 50-V., G.E.

MOTORS—3 PHASE, 60 CYCLES

No.	H.P.	R.P.M.	Volts	Type
1	500	450	2200/4000	G.E. Sl. Rg.
1	240	720	220	G.E. Syn.
2	200	514	220/440/4000	G.E. Syn.
4	200	450	2200/4000	G.E. Sl. Rg.
2	200	514	2200/4000	G.E. Sl. Rg.
1	400	514	440	G.E. Sq. Cg.
2	150	1160	440	G.E. Sq. Cg.
1	150	1200	2200	G.E. Syn.
1	150	1160	440	West. Sl. Rg.
1	150	1730	2200	G.E. Sq. Cg.
1	125	900	440	G.E. Sl. Rg.
2	100	900	440	G.E. Sl. Rg.
2	100	720		G.E. Sq. Cg.
1	100	600	220	G.E. Sl. Rg.
1	100	450	220	Sl. Rg.
1	100	1200	440	G.E. Sl. Rg.
1	79	1160	440	G.E. Sl. Rg.
1	75	1800	2200	G.E. Sq. Cg.
1	75	900	4150	Elec. Machy. Syn.
2	75	720	220	G.E. Sq. Cg.
1	75	600	220	West. Sl. Rg.
1	75	514	220	G.E. Sq. Cg.

Variable Speed 230 Volt Motors

H.P.	R.p.m.	Type
200	275/550	G.E.
125	475/950	Westinghouse
90	470/940	G.E.
75	235/950	Burke
60	600/1200	G.E.
50	400/1200	G.E.
35	500/1500	G.E.
35	500/1250	G.E.
30	600/1200	West.
30	225/900	Cr. Wheeler
20	750/1500	G.E.
20	375/1500	West.
20	400/1200	G.E.
4— 20	300/1200	G.E.
3— 15	300/1200	G.E.

J. L. HEMPHILL & CO., INC. 801 Williams St., No. Bergen, N. J.

NEW YORK LINE LONGACRE 5-3227

N. J. TEL. PALISADE 6-2600

BOILERS

1—650 HP 300 lb. pressure B&W boiler
2—250 HP Kroschelle Heine type boilers, 200 lb. pressure, with Westinghouse stokers
4—684 HP Edge Moor boilers, 200 lb. pressure
3—72x18′ HRT boilers, 150 lb. pressure, complete with or without stokers
5—823 HP Stirling water tube boilers with Westinghouse stokers, 160 lb. pressure, new, never fired
2—275 HP Bigelow Hornsby semi-vertical water tube boilers, 225 lb. pressure, with Riley stokers
2—250 HP Ames locomotive boilers, 150 lb. pressure, ASME code
1—3000 HP Hoppes horizontal open type feed water heater, entirely overhauled and guaranteed

OIL ENGINES

2—100 HP Fairbanks Morse, type Y, style V, oil engines; direct connected to 65 KW 250 volt DC generators, panel boards

TURBINES

2—500 KW, 3 phase, 60 cycle Westinghouse noncondensing turbines
1—2000 KW Westinghouse condensing turbine complete. Jet condenser
1—1250 KW General Electric extraction turbine, complete, surface condenser, all auxiliaries
1—750 KW Allis-Chalmers 3-60-2300 volts condensing turbine
1—5000 KW Westinghouse condensing turbine, surface condenser, complete
1—200 KW Kerr non-condensing turbine, 3 phase 60 cycle any voltage, direct connected exciter, panel
1—250 KW Kerr condensing turbine, 3-60-2300 volts

AIR COMPRESSOR

1—14x14x10 Sullivan angle compound air compressor, 900 cu. ft., 55 lbs. pressure; direct connected to a 120 HP vertical Fairbanks Morse full Diesel oil engine, only used 6 months

GENERATOR SETS

1—500 KW Ames vertical uniflow engine, 3-60-2300 volts
2—380 KW Skinner uniflow engine AC
1—300 KW Chuse Corliss engine, 3-60-2300 volts
1—150 KW Skinner counterflow, 3-60-220 volts
1—100 KW Skinner counterflow, 3-60-220 volts
1—100 KW Skinner counterflow, 3-60-600 volts
2— 75 KW Skinner counterflow, 3-60-2300 volts
1—Nordberg uniflow engine direct connected to 200 KW 3-60-480 volts generator, complete
1—22x28 Chuse non-releasing Corliss engine; direct connected to a 300 KW, 3-60-2300 volt generator

GENERATOR

1—160 KW Crocker-Wheeler 250 volt DC generator, 257 RPM, with switchboard panel

The above is only a partial list. List your equipment with us.

FLETCHER SALES COMPANY

835-130 E. Washington Building — Indianapolis, Indiana

SLIP RING MOTORS, 3-PH., 60-CY.

HP	Volts	Make	Speed
300	2200-440-220	G.E.	1200
250	440-220	G.E.	450
220	440-220	G.E.	600
200	2200-440-220	G.E.	600
150	2200-440	Whse.	1800
150	2200-220-440-550	G.E.	720
100	2200-440-220	Westghse.	1200
100	2200-220-440-550	G.E.	720
100	440-220	G.E.	900
75	440-220	G.E.	1200
60	440-220	G.E.	1200
50	2200-440-220	G.E.	1200
50	220-440	G.E.	900

SYNCHRONOUS MOTORS 3-PH., 60-CY.

600	2300	Elec. Mchy.	1800
240	2300-550	G.E.	900
240	2200-440-220	G.E.	600
200	440-220	G.E.	720
160	2200-550	G.E.	900
120	440-220	G.E.	900
120	2200-440-220	G.E.	1200
60	2200-440-220	G.E.	1200

A. C. GENERATORS

1—312 KVA 900 r.p.m., 2300 V., Westghse.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—225 kva., 900 r.p.m., 2300-550 V., G.E.
1—187 KVA 900 r.p.m., 2200-550 V., Westghse.
1—150 kva., 900 r.p.m., 2300-550-V., G.E.
1—112½ kva., 1200 r.p.m., 2200-240-480-V., G.E.
1—112½ kva., 900 r.p.m., 480-240-V., G.E.
1—62½ kva., 600 r.p.m., 2300-240-480-V., G.E.
1—60 kva., 1200 r.p.m., 240-480 V., Fair.-Morse.
1—56 kva., 1200 r.p.m., 2200-240-480-V., G.E.
1—37½ kva., 1200 r.p.m., 2200-240-480-V., G.E.
1—15 kva., 1200 r.p.m., 240-480, G.E.

TRANSFORMERS—60 CYCLE

3—1667 kva., G.E., type H-D, 66000-22000/11000.
3—1500 kva., G.E., type H-D, 23000-2300/4000 Y.
3—333 kva., Westghse., 13,200/26400-230/460.
4—200 kva., Pittsburgh, type OISC, 13200-460.
3—150 kva., G.E., type H-KD, 4000-230/460.
3—150 kva., G.E., Type H-KS 2300-230/460.
3—100 kva., G.E., type H-KR 6600/13200-2300.
3—100 kva., Westinghouse, 13200-115/230.
3—100 kva., Pittsburgh 2400-240.
3—75 kva., G.E., Type H-KS 2300-115/230.
3—50 kva., G.E. type H-K 2400-240/480.
3—50 kva., Pittsburgh, 13800-120/240.
3—25 kva., G.E., type H-KR 11500-230/460.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
220	550	Whse.	CS	720
200	550-440-220	G.E.	IK	600
150	2200-440-220	Whse.	CS	600
150	440-220	G.E.	IK	720
150	440-220	G.E.	KT	900
100	440-220	G.E.	IK	600
100	2200-550	G.E.	IK	1800
100	2200-550	G.E.	KT	900
75	220-440	G.E.	KT	900
60	220-440	G.E.	KT	900
50	220-440	G.E.	KT	900
40	220-440	G.E.	KT	900

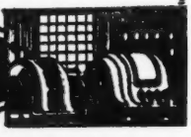
D.C. GENERATORS

75	125	RC	G.E. 1150
75	250	RC	G.E. 1100
75	250	RC	G.E. 750
50	125	CD	G.E. 1150

MOTOR GENERATOR SETS

1—200 kw., 250 V., 1200 r.p.m., Electric Machinery, connected to 233 kva., 2300/4000 V., 60 cy., synchronous motor.
1—75 kw., 125 V., 1200 r.p.m., G.E., type RC connected to type ATI, 115 H.P., 220/440/550 V., 60 cycle, syn. motor.

STEPHEN HALL & COMPANY, INC.
7th and Adams St., Hoboken, N. J.



Engine & Turbine Units
(Alternating Current)

KVA	Make
3150	G.E.—Bleeder Turbine
1250	G.E.—G.E. Turbine
750	G.E.—Ames Uniflow
750	G.E.—Nordberg Uniflow
750	G.E.—Non. Con.; Turbine
625	G.E.—Nordberg Uniflow
500	G.E.—Erie Ball 4 V.
450	G.E.—Skinner Uniflow
375	C.W.—Terry Turbine
250	G.E.—Non. Con.; Turbine
165	Wghse.—Harrisburg
150	Wghse.—Erie Ball 4 V.
125	Burke-Ames
125	G.E.—G.E. Turbine
125	G.E.—Skinner Uniflow
112	G.E.—De Laval Turbine
70	G.E.—Ridgeway

UNIFLOW

600 KW G.E. 3-60-440 V. Alternator with Ames Uniflow Engine.

TURBINE UNIT

375 KVA, Allis-Chal. Alternator with Elliott 7 stage Turbine, Exciter, Switchboard and Wheeler Surface Condenser. Installed "1928." Condition like new
250 Volt, 3 Wire Unit
200 KW Ridgway-Ridgway 4 V. Engine

Engine & Turbine Units
(Direct Current)

KW	Make	Volts
500	G.E.—Skinner Uniflow	250
300	G.E.—Turbine	125
250	G.E.—Erie Ball 4 V.	250
200	Wghse. Turbine	125
200	Wghse.—Murray Uniflow	250
200	Rdgw.-Rdgw. 4 V.	250
150	C.W.—Erie Ball 4 V.	250
150	C.W.—Erie Ball 4 V.	125
100	G.E.—Skinner Uniflow	250

BOILERS

2—600 HP B. & W., 200 lbs. ASME
1—413 HP. Wickes, 200 lbs. ASME
2—300 HP. B. & W., 200 lbs. ASME

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NEW G. E. MTC 3 ph. 60 cy. MOTORS

1—15, 9—20, 7—25, 1—40, 9—50 H.P.
NEW Allen Bradley F2304 CONTROLS

9—50 HP. 7—20 HP.
NEW G. E. CR 9510 Solenoid BRAKES.

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2375 Cu.Ft. Worth Steam Driven
1775 Cu.Ft. I. R. Duplex—25 lbs.
316 Cu.Ft. I. R. Direct Motor Drive
173 Cu.Ft. Sull. Belt Drive

1—37½ K.W. Diesel-Gen. 3-60-220 V.

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60 Cycle, 110/220/440 Volt—½ H.P. to 300 H.P.

SLIP RING MOTORS—
60 Cycle, 220/440 Volt—2 H.P. to 150 H.P.

SINGLE PHASE MOTORS—
60 Cycle, 110/220 Volt—¼ H.P. to 10 H.P.

D. C. MOTORS—
115/230 Volt—¼ H. P. to 40 H.P.

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2500 KW Capacity-Turbo Generator, 60 cy. 3 ph.-Surface Condenser—Boilers and complete modern plant auxiliaries, piping, etc.

BOILERS

2—1000 HP Edge Moor, 200#
2— 590 HP Edge Moor, 240#
1— 723 HP Stirling, 200#
2— 229 HP Edge Moor, 225#

DIESEL OIL ENGINE UNITS

2— 485 KW Winton, 60 cy. 3 ph. 480 v. all auxiliaries, two years old.
1— 150 KW Lomb. Gen Elec., 60 cy., 3 ph.

TURBO-GENERATORS—60 cy. 3 ph.

1—4000 KW G. E. Condensing
1—3000 KW West. Condensing
1—2500 KW G. E. Condensing
1—1500 KW G. E. Extraction
1—1500 KW West. Non-Cond. Press. 450# Exh. 30#—150#
1—1000 KW G. E. Non-Cond.
1— 500 KW West. Non-Cond.
1— 300 KW West. Non-Cond.
1— 300 KW Allis Non-Cond.

1—2000 KW *Turbo Gen. Unit, DeLaval-Crocker Wheeler,* 250/125 v. 3 wire, D. C.

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Rochester, N. Y.

MOTORS ALL TYPES — GENERATORS — CONTROLS — TRANSFORMERS — MOTOR GENERATOR SETS

60 Cycle—3 Phase—Slip Ring Motors

HP	Make	Voltage	Speed
75	Gen. Electric	440	1200
100	Westinghouse	550	690
150	Westinghouse	440	514
150	Westinghouse	550	580
150	Westinghouse	440	690
150	Westinghouse	440	600
175	Ideal	2200	1750

60 Cycle—3 Phase—Synchronous Motors

50	Elec. Mfg. Co.	220	1200
50	Ridgway	440	1200
125	Westinghouse	4000	1800
125	Fairbanks-Morse	220	1200
200	Gen. Electric	240	720

60 Cycle—3 Phase—Sq. Cage Motors

75	Allis. Chal.	2200	1750
75	Westinghouse	2200	1750
100	Allis Chalm.	440	690
100	Westinghouse	440	690
100	Gen. Electric	440	450
150	Allis. Chal.	440	1140
150	Westinghouse	440	580
200	Allis Chal.	2200	1160
200	Gen. Electric	4100	600
200	Westinghouse	2200	600
200	Gen. Electric	440	495
250	Gen. Electric	2300	400

60 Cycle—2 Phase—Sq. Cage Motors

112	Westinghouse	2200	695
150	Burke	440	900
150	Westinghouse	440	695
150	Westinghouse	2200	720

60 Cycle—3 Phase—Alternators

HP	Make	Voltage	Speed
15	KVA Gen. Elec.	220	1200
40	KVA Ridgeway	440	1200
90	KVA Lincoln	220	1200
90	KVA F. & M.	220	1200
100	KVA Gen. Elec.	240	900
150	KVA Gen. Elec.	240	720
200	KVA Allis. Chal.	240	900
250	KVA Allis. Chal.	2200	600

25 Cycle—3 Phase—Alternators

120	KVA Gen. Elec.	2200	750
150	KVA Westghse.	440	500
150	KVA Elec. Mchy.	440	750

Direct Current Generators

50	KW Westghse.	125	750
75	KW Gen. Elec.	250	300
100	KW Gen. Elec.	125	550
150	KW Gen. Elec.	125-250	500

25 and 60 Cycle MG Sets

35 KW Gen. Elec. DC Generator, 125 Volts Conn. to 50 HP 220 V., 60 cy., 1500 RPM motor.
75 KW Gen. Elec. DC Generator, 125 Volts, Conn. to 100 HP SC 220 V., 60 cy. 750.
100 KW Gen. Elec. DC Generator, 125 V., Conn. to 150 HP SC Motor, 220 V., 25 cy., 500.
100 KW Gen. Elec. DC Generator, 125 Volts Conn. to 150 HP SC Motor, 220 V., 60 cy., 600 Speed.
150 KW West. DC Generator, 275 Volts Conn. to 225 HP Syn. 60 cy., 440 V., 900 Speed.

25 Cycle—3 Phase—Slip Ring Motors

HP	Make	Voltage	Speed
100	Wagner	440	750
100	Gen. Elec.	440	350
150	Gen. Elec.	2200	500
150	Gen. Elec.	440	500
200	Westinghouse	440	725
200	Westinghouse	440	725
200	Gen. Elec.	440	500
200	Westinghouse	440	485
350	Gen. Elec.	220	375
450	Westinghouse	440	365

25 Cycle—3 Phase—Sq. Cage Motors

100	Allis Chal.	440	480
100	Westinghouse	440	480
100	Gen. Elec.	220	730
125	Allis Chal.	440	480
150	Crocker Wheel.	2300	720
200	Gen. Elec.	2300	720
200	Allis Chal.	440	480
250	Allis Chal.	440	480
300	Westinghouse	440	720
350	Allis Chal.	440	480

D.C. Motors

40	Gen. Elec.	230	860
40	Gen. Elec.	110	915
40	Gen. Elec.	110	935
40	Gen. Elec.	230	700/1000
50	G.E. Sprague	230	650/1000
60	G.E. Sprague	230	600
60	Gen. Elec.	230	650
85	Gen. Elec.	230	860
100	Northwestern	230	1750
100	Reliance	230	1100

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Specially Priced for quick sale

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3—200 H. P.	H.R.T. 150 lbs.	1—110 H. P.	Economic 125 lbs.
3—150 H. P.	H.R.T. 150 lbs.	1—100 H. P.	Economic 100 lbs.
1—125 H. P.	H.R.T. 125 lbs.	1— 80 H. P.	Vertical 114 lbs.
1—100 H. P.	H.R.T. 150 lbs.	1— 70 H. P.	Vertical 100 lbs.

1— 50 H.P. Vertical 125 lbs.

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Used—14x9x10 **Sullivan WJ Duplex** 336 cu. ft. **Compressor.**

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200 KW **Murray Uniflow,** 125/250 Volt D.C.
100/150 KW 3/60/220 V. **Steam Engine Units.**
7500 HP **Cochrane Feed Water Heater.**
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210 HP 3/60/440 V Modern **Fairbanks Diesel.**
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Ingersoll-Rand Type 10
22"x16"x13"; 1190 c.f.m.

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20"x12"x14"; 1094 c.f.m.

Chicago Pneumatic Type GCB
22"x14"x16"; 1055 c.f.m.

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15"x9"x12"; 546 c.f.m.

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17"x10½"x12"; 870 c.f.m.

Ingersoll-Rand Type 10
12"x7½"x12"; 327 c.f.m.

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10"x4½"x10"; 250 c.f.m. at 400 lb pressure.

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1—20 KW. **G.E.** RC-36 as above. **$900.**
1—600 c.f.m. **Chi. Pne.** 15x9x10 OCB 100#, 2 stage compressor complete with 100 H.P. motor, starter, etc. **$2250.**
1—850 ft. XB **Ingersoll-Rand** with 150 H.P. three phase, 60 cycle, 220/440 volt motor. **$1650.**
1—830 c.f.m. **Chi. Pne.** Tool Co. OCB 17x10x12 compressor with 150 H.P. G.E. 3 phase, 60 cy. 220/440 v. motor and control. **$2600.**
1—200 H.P. **Allis Chalmers,** 900 rpm, 3 phase, 60 cycle, 220/440 volt, syn. motor, d.c. exciter. Complete with starter. **$1000.**
1—100 H.P. **Allis Chalmers,** 1800 rpm. syn. motor as above. **$600.**

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2—Westinghouse, 3,000 KW, 3/60/2,400-v, 200#-500 deg. T.T. Condensing.
2—Allis-Chalmers, 2,500 KW, 3/60/6,600-v, 250#-500 deg. T.T. Condensing—New.
1—General Electric, 15-STAGE, 2,000 KW, 3/60/480-v, 175#, 150 deg. T.T. Condensing.
1—Westinghouse, 1,250 KW, 3/60/6,600-v, 200 lbs., Mixed Pressure.
1—General Electric 1,250 KW, 3/60/480-v, Aut. Extraction, 200#-500, 15 to 20 lbs. extraction.
1—General Electric, 1,000 KW, 3/60/2,300-v, 175#, 10# Back Pressure, Non-condensing.
1—Allis-Chalmers, 1,250 KW, 3/60/480-v, 200#-450 deg. F.T.T. Condensing.
1—Allis-Chalmers, 750 KW, 3/60/480-v, 200#-450 deg. T.T. Condensing. Surface Condenser.
1—General Electric, NEW, 750 KW, 3/60/2,300-v, 250#-600 deg. F.T.T. Mixed Pressure. Condensing.
1—Westinghouse, 500 KW, 3/60/480-v, 250#-600 deg. T.T. Automatic Extraction. Condensing. Used 11 days.

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6—75 KVA G-E 23000–230/460 V.

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1—300 HP, 720 RPM, type ATI, GE, with direct connected exciter.
1—150 HP. 900 RPM, synchronous with belted exciter.
1——150 HP, 1200 RPM, Allis Chalmers synchronous, direct connected exciter.
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6—200 HP, 450 RPM, type LK-17 GE motors.
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1—75 HP, 900 RPM, Howell slip ring with control.
2—100 Vertical CS Westinghouse, 1200 RPM.

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62.5 K.W. GE Generator, 230 V, DC, 300 amp, 500 RPM.
25 K.W. Triumph Generator, 230 V, DC, 102 amp, 1080 RPM.
25 K.W. Imperial Generator 125 V, DC, 200 amp, 300 RPM.
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Three 150 KW and 1-100 KW Direct Current 240 v. GE generators direct connected to 4 valve Corliss, Rice and Sargent engines 150 RPM. In perfect condition throughout.
1—150 KW 240 vo. DC Crocker Wheeler gen. direct connected Harrisburg Fleming 4 valve engine.
1—200 KW Crocker Wheeler DC gen. to Kerr Turbine; reduction gears, auxiliaries.

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75 KW GE 220/110 DC direct connected to Ideal Piston Valve Engine.
75 KW, 70 KW, 90 KVA, 50 KW, 3/60/220 Generator dir. con. to Harrisburg Piston-valve engines.
90 KW, 250 volt, DC Crocker-Wheeler 530 RPM belted generator.
7½ KW and 10 KW, 120 volt, DC geenrators, American Blower vertical engines.
30 KW, 250 volt, DC generator, connected to 50 HP 220 volt motor.
200 HP 3 ph 60 cycles Synchronous Motor, shaft, outboard bearing, Allen Bradley starter, exciter.
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1500 KW Allis Chalmers condensing, 480-600-2400 volts, 150#

1500 KW Westinghouse non-condensing turbine only, 150-300#, 600 deg. TT, 0-30# back pressure

1250 KW General Electric automatic extraction, 240-480 volts, 150-200# 0-30# extraction

1000 KW Westinghouse condensing, 480-600-2400 volts, 150-225#, 525 deg.

750 KW Allis Chalmers condensing, 480-600-2400 volts, 150-200#

500 KW Westinghouse condensing, 240-480-600-2400 volts, 150-200#, 525 deg. TT

300 KW Westinghouse non-condensing, 240-480-600-2400 volts, 100-125#, 0-5# back pressure

ENGINE GENERATOR SETS

3 PHASE 60 CYCLE

720 KW General Electric-Hamilton twin Corliss, 2300-600-480-240 volts, 100-150#, 0-15 back pressure

600 KW Electric Machinery—Nordberg uniflow, 240-480-600-2300 volts, 170-200#, 0-25# back pressure

540 KW General Electric-Chuse Corliss, 240-480-2300 volts, 100-125#, 0-6# back pressure

400 KW Allis Chalmers-Harrisburg uniflow, 240-480-600-2300 volts, 140-160# 0-10# back pressure

250 KW Allis Chalmers-Nordberg uniflow, 240-480-600-2300 volts, 125-200#, 0-40# back pressure

100 KW Westinghouse-Erie Corliss, 240-480-600-2300 volts, 150# 0-5# back pressure

MOTOR GENERATOR SETS

3 PHASE 60 CYCLE

600 KW Allis Chalmers synchronous, 250 volts, D.C. 2300 volts A.C.

100 KW Westinghouse synchronous, 250 volts D.C. 220-440 volts A.C.

This is a partial list. Send us your inquiries.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON RD. CLEVELAND, OHIO

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

1—300 KW. 250 volt, DC 2200 or 4000 V. 3 ph. 60 cy. AC G.E. 35% P.F. syn. motor for P.F. correction
1—300 KW. 250 V. DC cp.wd. 1200 rev. Westg. Ped. Rotary Converter with 10,000-6900-4000-2200 V. Trans. and swbd.
2—200 KW. 250/275 V. DC 1200 rpm. 4000/2200 V. AC Westg. 6 ph. ped. type Rotary Converters
2—150 KW. 250 V. DC 2200 or 4000 V. 3 ph. 60 cy. AC Westg. syn. MG sets
1—150 KW. 250 V. DC 22000 or any lower voltage Primary Gen. Elect. syn. converter
1—100 KW. 250 V. DC 2200 or 440 V. AC Westg. Induction MG set
1—100 KW. 250/275 V. DC 1200 rpm. 2300/4000 V. AC Westg. 6 ph. ped. type Rotary Converter

ENGINE GENERATOR SETS

1—500 KVA 240 V. 3 ph. 60 cy. Gen. Elect. Gen. dir. con. to Erie Ball Steam Engine
1—500 KW. 2300 V. 3 ph. 60 cy. Gen. Elect. dir. con. to 6 cyl. Ingersoll-Rand Oil Eng.
2—450 KVA 220/440/2200 V. 3 ph. 60 cy. Gen. Elect. gen. dir. con. to 2 Skinner Uniflow Steam Eng.
2—275 KW. 2300-550 or 220 V. 3 ph. 60 cy. Gen. Elect. gen. dir. con. to 2 Price-Rathburn Oil Eng.
1—150 KW. 250 V. DC Westg. Gen. dir. con. to Erie City Steam Eng.
1—125 KW. 240 V. DC Allis-Chal. Gen. dir. con. to Skinner Steam Eng.
1—100 KW. 125/250 V. DC 3 wire Westg. Gas Eng. gen. set consisting of 2-50 KW. 125 V. Gen. and Gas Engines
1—100 KW. 220 or 440 V. 3 ph. 60 cy. Allis-Chal. Kerr NON cond. Turbine Set
1—75 KW. 250 V. DC Ridgway Gen. dir. con. to Ridgway Steam Eng.
2—50 KW. 125 V. DC Westg. Gen. dir. con. to 2 Westg. 3 cy. vert. Gas Engines
1—17 KW. 125 V. DC Northern Gen. dir. con. to Russell Steam Eng.

AIR COMPRESSORS

1—2210 cu. ft. 100 lb. Chicago Pneu. Steam Dr.
1—810 cu. ft. 100 lb. Burry 2300 V. syn. motor
1—534 cu. ft. 100 lb. Ingersoll-Rand
2—485 cu. ft. 60 lb. Ingersoll-Rand
1—300 cu. ft. 100 lb. Ingersoll-Rand
1—40 cu. ft. 100 lb. Sullivan
1—15 cu. ft. 100 lb. Wilson Snyder Steam Drive

SLIPRING MOTORS

1—200 HP. 500 rpm. 440-220 V. 3 ph. 60 cy. CW Westg.
1—200 HP. 580 rpm. 2200 V. 3 ph. 60 cy. CW Westg.
1—200 HP. 585 rpm. 220/440 V. 3 ph. 60 cy. G.E. complete with starting equipment
4—500 HP. 435 rpm. 2200 or 4000 V. 3 ph. 60 cy. G.E. with auto control equipment
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1—200 kw. Westinghouse 3-60-220/440—600 speed alternator complete with belted exciter, exciter rheostat, slide rails, for alternator and exciter.

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1—400 KW, 2300 Volt, 60 cycle, 3 phase turbine generator set connected to a La Blanc-Jett condenser with direct connected motor driven pump.

This turbine has been in service about 22 years.

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1—2¼"x6" Deane, 740 lbs. pressure. Motor Driven.

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1—13"x14" Worthington 522 C.F.M.
2—12"x10" Ingersoll Rand 368 C.F.M.
1—10"x9" Penna. 240 C.F.M.

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1—72"x18' Ames H.R.T. 125 lbs. Complete with Stack and Iron Fireman.
2—80 H.P. Erie City Economic 100 lbs.
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3 PH., 60 CY.

1—50 KVA Ridgeway 220-240 vo., D.C. to 8"x12" Ridgeway Engine.
1—60 KVA General Electric 240 vo., D.C. to 11"x12" Ball Engine.
1—100 KVA General Electric 240 vo., D.C. to 15½"x14" Harrisburg Engine.
1—150 KVA General Electric 2300 vo., D.C. to Harrisburg Four Valve Engine.

SLIP RING MOTORS

3 PH., 60 CY., 440 VO.

1—60 H.P. General Electric MT 516, 1200 RPM.
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2—40 H.P. General Electric MT 336, 1200 RPM.

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100 KW. 3 phase 60 cycle 2300 volt 3600 rpm General Electric Curtis turbine, 150 lb. pressure, non-condensing.
1500 KW. 3 phase 60 cycle 600 volt 3600 rpm General Electric Curtis turbine, 150 lb. pressure, condensing, complete with condenser and switchboard.

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200 HP. 3 phase 60 cycle 600 volt 257 rpm Westinghouse.
250 HP. 3 phase 60 cycle 2300 volt 257 rpm General Electric.
400 HP. 3 phase 60 cycle 2300 volt 1200 rpm General Electric.
242 HP. 2 phase 60 cycle 2300 volt 514 rpm General Electric.
400 HP. 3 phase 60 cycle 600 volt 257 rpm Westinghouse.

A.C. GENERATORS

225 KW. 3 phase 60 cycle 600 volt 600 rpm Allis-Chalmers 3 bearing.
300 K.V.A. 3 phase 60 cycle 600 volt 720 rpm General Electric 2 bearing.
312 K.V.A. 3 phase 60 cycle 600 volt 257 rpm Westinghouse.

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3—150 K.V.A. single phase 60 cycle 2300 volt primary 220/440 volt secondary General Electric.

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60 HP. 3 phase 60 cycle 220 volt 1800 rpm General Electric MTC intermittent duty motor.
25/100 HP. 115/230 volt 250/1000 rpm Westinghouse D.C. variable speed motor type SK, complete with control panel.
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400 amp. Westinghouse 16 KW. 40 volt, direct connected exciter, direct connected to 25 HP. Westinghouse 3 phase 60 cycle type CS motor.
3—Gasoline driven welders 200 amp. Westinghouse type SK direct connected to 6 cylinder vertical Winton engines.

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9x8 Sullivan compressor.
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2—9½x12 Laidlaw-Worthington.
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7½x6 Chicago Pneumatic NSB horizontal

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25 HP. 325 RPM. Fairbanks-Morse type Y

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4—500 HP. General Electric Motors, Type I Form K, 3 Phase, 60 Cycle, 2200 volt, 1800 RPM.

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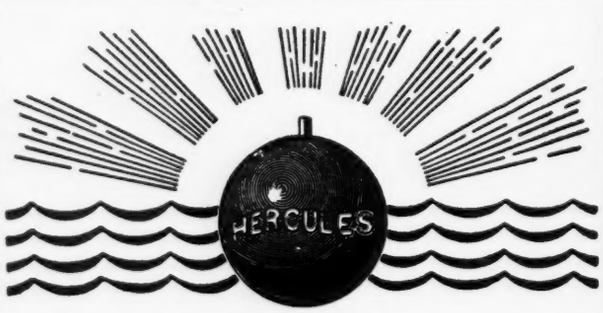

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Now available in 75 and 100 kilowatt sizes.

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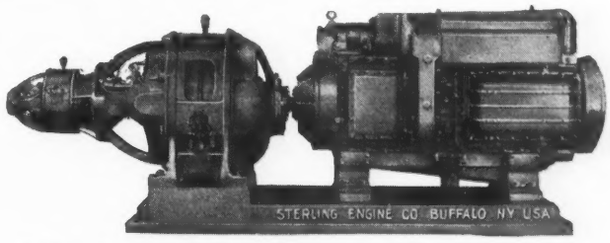
Gas—Gasoline—Oil Engines



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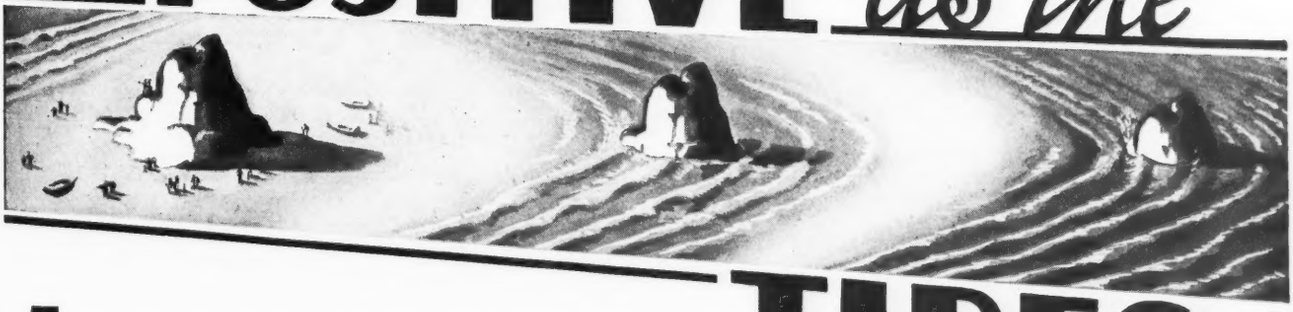

THE positive functioning of the Coe Drainator is as dependable as the ebb and flow of the tides. Undisputable, unchangeable, physical laws positively control the operation of the Drainator, as they have governed the tidal movement of the seas.

It was the destiny of Sir Isaac Newton to discover the law which governs the tidal flow and offer his discovery to the world.

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Write for complete information.

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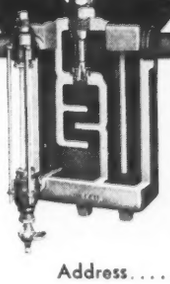

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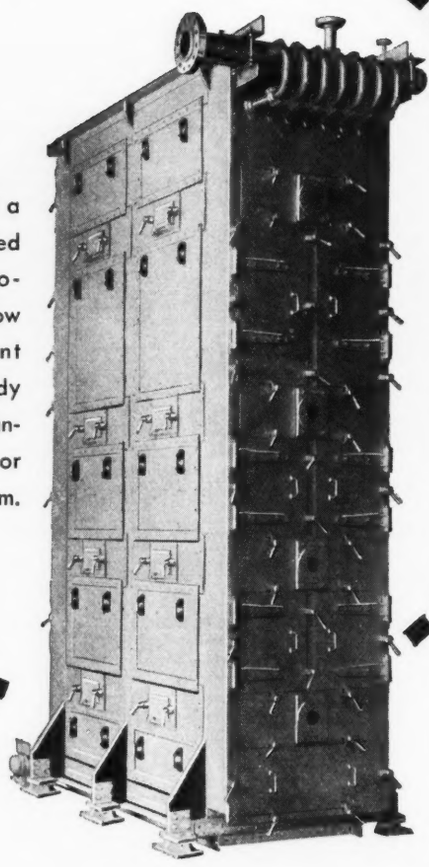

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2 WAYS TO *reduce* BOILER COSTS

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2. **Increase CAPACITY by delivering hotter feed water to the boiler.**

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Many plants operating at capacity have obtained a needed increase in boiler capacity—at nominal cost—by installing a Green's Extended Surface Economizer . . . and NO plant can operate at an efficient fuel rate without an economizer to recover the waste heat from the flue gases.

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It is a Spherical Steam Header operating at 925 degrees F. maximum temperature and 1250 lb. p. s. i. pressure for Unit No. 4 of the Waterside Station of the Consolidated Edison Company of New York, Inc. where it will handle the output of two 500,000 lb. per hour boilers operating a 50,000 K.W. steam turbine.

Steam from the boilers will enter the header through two 12" leads and be carried to the turbine throttle valve by one 20" connection. The sphere is made of carbon ½% Molybdenum forged steel 2 3/16" thick and is 48" O. D. The two hemispheres were Masterwelded together in accordance with Paragraph U-68 of the A. S. M. E. Code for Unfired Pressure Vessels.

This new form of Spherical Steam Header is light in weight, requires little space, operates with high efficiency and furnishes steam of a uniform temperature to the turbine.

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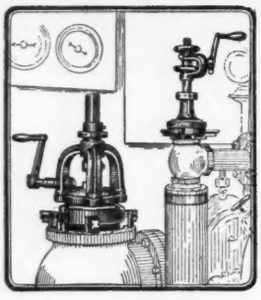
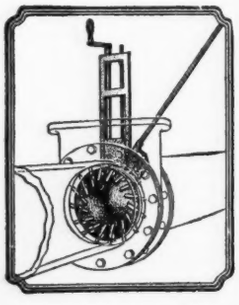
—IN PLACE



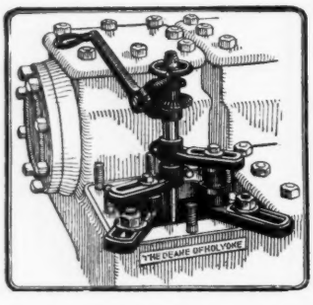
● *for* GLOBE *valves*

Plants all over the world are using this machine. Made in various capacities for small plants and large plants. Operation is simple. Results are positive. Universal and adapted for all types of globe and angle valves.

● *for* GATE *valves*



Solved the problem for plants using gate valves by enabling them to reseat the leaking gate valves in place. The seats and gate or split discs are refaced exactly alike—making a tight seating valve. It is made for gate valves as small as one and one half inches and as large as thirty inches.



● *for* PUMP *valves*

Reciprocating pumps can be kept operating at full efficiency by keeping the seats smooth and true. This machine is attached to the studs on the pump valve chamber and the seats refaced in place. Consider the advantages and value of this machine when the seats are driven in on a taper and cannot be readily removed.

The investment in a layout of these machines for keeping your valves tight is an excellent one. Write now for Catalog No. 24 describing all of these machines.

(Also manufacturers of the Swendeman Automatic Separator)

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10 East River Street Orange, Mass.

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Get More Out of Life By Getting More Out of Your Packing

HE MEANS, of course, that you can do away with many of those pesky repacking jobs on Sundays and holidays by using that longer lasting packing—Chesterton Number "64."

Note these important man-to-man features of "64" packing:

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—it will not grow hard in the stuffing box because it has a specially developed binder which stubbornly resists the action of intense heat. No ordinary rubber cement is used.

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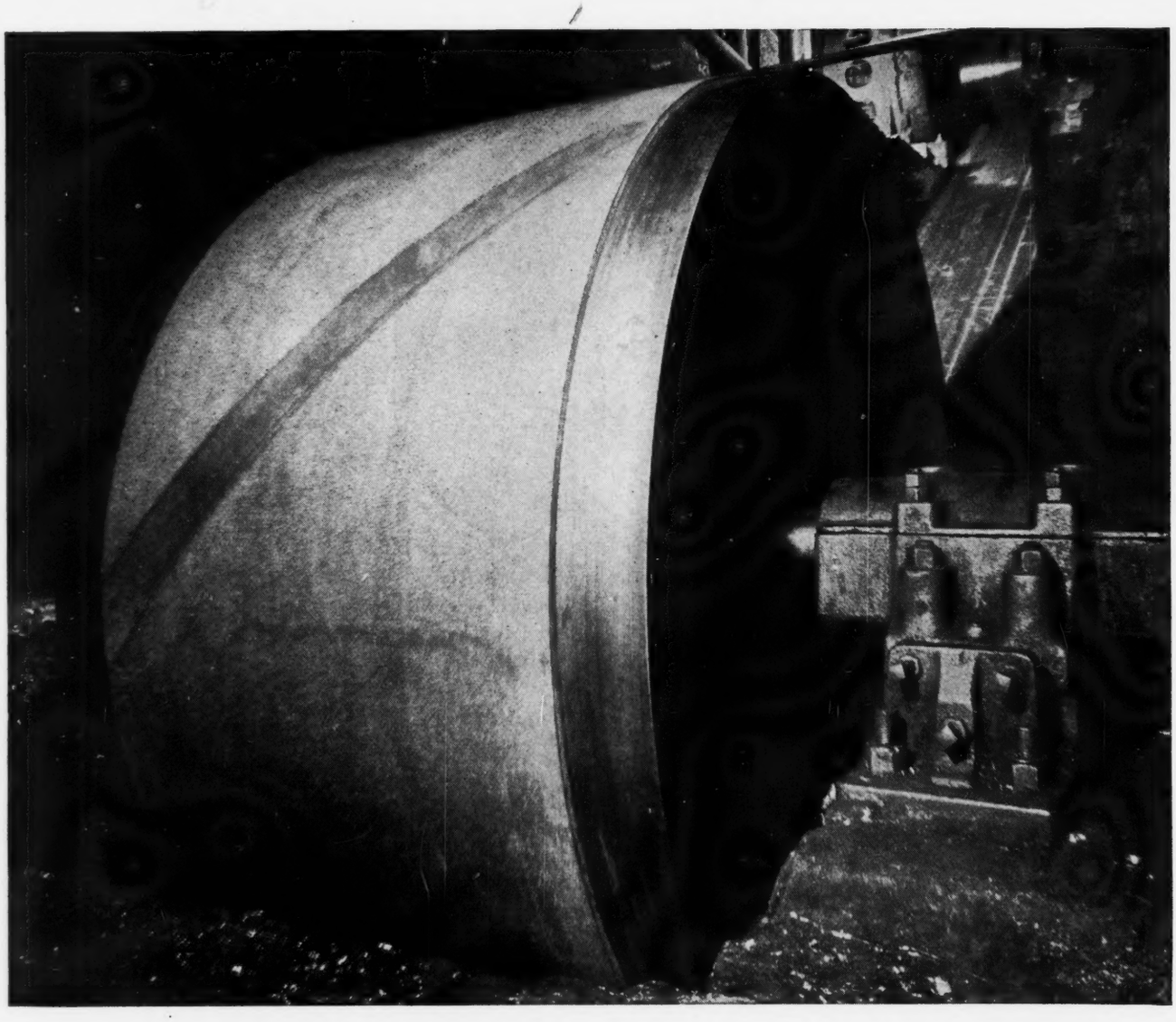

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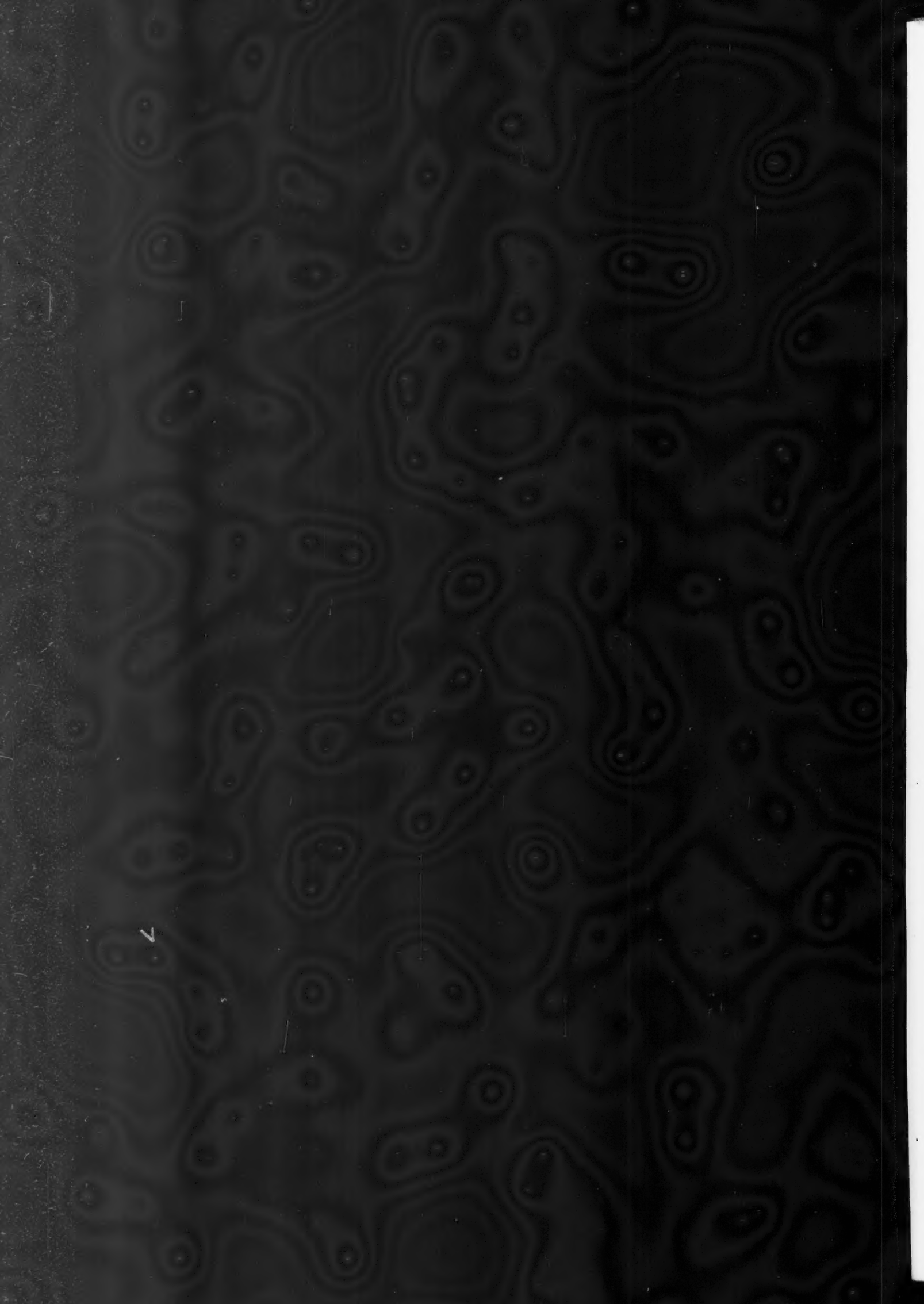
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